Updated 10/23/19

Orange Water and Sewer Authority

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

Agenda
Meeting of the OWASA Board of Directors
Thursday, October 24, 2019, 7:00 P.M.
Chapel Hill Town Hall

In compliance with the "Americans with Disabilities Act," interpreter services are available with five days prior notice. If you need this assistance, please contact the Clerk to the Board at 919-537-4217 or aorbich@owasa.org.

The Board of Directors appreciates and invites the public to attend and observe its meetings. Public comment is invited either by petition upon topics not on the Board's agenda, or by comments upon items appearing on the Board's agenda. Speakers are invited to submit more detailed comments via written materials, ideally submitted at least three days in advance of the meeting to the Clerk to the Board via email or US Postal Service (aorbich@owasa.org/400 Jones Ferry Road, Carrboro, NC 27510).

Public speakers are encouraged to organize their remarks for delivery within a four-minute time frame allowed each speaker, unless otherwise determined by the Board of Directors.

Announcements

1. Announcements by the Chair
   - A. Any Board Member who knows of a conflict of interest or potential conflict of interest with respect to any item on the agenda tonight is asked to disclose the same at this time.
   - B. Update on the October 16, 2019 Special Meeting of the Board of Directors
   - C. Update on the October 22, 2019 Orange County Climate Council Meeting
   - D. Members of the Orange County Board of Commissioners and Orange County Appointees to the OWASA Board will meet on Thursday, November 14, 2019 at 8:30 a.m. in the OWASA Boardroom
2. Announcements by Board Members
   - A. Update on Chapel Hill Town Council OWASA Committee and Chapel Hill Appointees to the OWASA Board of Directors Meeting on Thursday, October 17, 2019 (Ruchir Vora)
   - B. Update on the October 22, 2018 Finance Committee Meeting (Bruce Boehm)
3. Announcements by Staff
   - A. OWASA Employee Service Awards (Ed Kerwin)
   - B. Update on the October 19, 2019 Chapel Hill Peoples Academy/Carrboro Citizen's Academy – OWASA Session (Ed Kerwin)
4. Additional Comments, Suggestions, and Information Items by Board Members (Ray DuBose)

Petitions and Requests

1. Public
2. Board
3. Staff

Consent Agenda
Information and Reports

1. 12 Month Board Meeting Schedule (Ray DuBose/Ed Kerwin)

Action

2. Minutes of the October 10, 2019 Closed Session of the Board of Directors for the Purpose of Discussing a Personnel Matter (Robert Morgan)
3. Adopt Series Resolutions for Series 2019 Revenue Bonds and Series 2020 Revenue Refunding Bonds (Stephen Winters)

Regular Agenda
Discussion

4. Care to Share Customer Assistance Day (Linda Low)
5. Water Main Break and Water Treatment Plant/Wastewater Treatment Plant Reliability and Risk Assessment Action Plans Progress Report (Todd Taylor/Mary Darr)

Information and Reports

* 6. Administration of Strategic Plan:
    A. Annual Review and Update of Strategic Trends and Utility Planning Issues (Ruth Rouse)
    B. Strategic Plan Progress Report (Staff)
7. Financial Report for the Three-Month Period Ended September 30, 2019 (Stephen Winters)

Summary of Board Meeting Action Items

8. Executive Director will summarize the key action items from the Board meeting and note significant items for discussion and/or action expected at the next meeting

OWASA Board of Directors – 12 Month Board Meeting Schedule (October 18, 2019)

Month	Board Meetings		Committee & Other Meetings
	Work Session	Business Meeting	
October 2019	Approval of Sole Source Procurement of Water Treatment Plant Process Equipment Sewer Use Ordinance Update Update on Rogerson Drive Force Main Emergency Repair and Cost Estimate Response to a Board Petition regarding an Update to the 1996 Cane Creek Reservoir Watershed Study CS – ED Annual Review (↻) 10/10/2019	Q1 Financial Report (↻) **Strategic Trends Report and Strategic Plan Update** (↻) Adopt Series Resolution for Series 2019 Revenue Bonds and Series 2020 Revenue Refunding Bonds Water Main Break and WTP/WWTP Reliability and Risk Assessment Action Plans Progress Report Customer Assistance Program Care to Share Day 10/24/2019	*Agua Vista Update to the Chapel Hill Town Council (10/2/2019)* *Chatham-Orange County Joint Planning Task Force (10/3/2019)* *New Board Members D&I Session with VISIONS, Inc. (10/8/2019)* *Special Meeting to Interview Consultants for Executive Search Services (10/16/2019)* *Chapel Hill OWASA Board Members meet with TOCH OWASA Committee (10/17/2019)* *Finance Committee Meeting (10/22/2019)*
November 2019	**LRWSP Update on Schedule and Process** Approve Round 4 Jordan Lake Allocation Contract Discuss Work Plan for ED CS – Personnel Matter 11/14/2019	*Holiday – no meeting*	*OC Appointees to the OWASA Board meet with Members of Orange County BOCC (11/14/2019)* *(Tentative) HR Committee Review ED Search Scope of Work (TBD)* *Finance Committee Meeting to Review Banking Proposals (TBD)*
December 2019	MWBE Contractor Participation Information Comparison **LRWSP – Preliminary Risk Modeling** Approve New Banking Services Provider 12/12/2019	*Holiday – no meeting*	
January 2020	Appoint Audit Firm (↻) Employee Health and Dental Insurance Update for FY 21 (↻) Review Comments on Sewer Use Ordinance Update Affordability Outreach Program Update Diversity and Inclusion Update 1/9/2020	Annual Lakes Recreation Report (↻) CIP Semiannual Report (↻) Q2 Financial Report (↻) FY 21 Budget Calendar and Assumptions (↻) Approve Sewer Use Ordinance Update Award the WTP Chemical Facility Improvements Contract Award the Kings Mill-Morgan Creek Neighborhood Water Main Replacements Contract 1/23/2020	***(Tentative) Special Meeting on the LRWSP – Draft Evaluation of Water Supply and Demand Management Alternatives* (TBD)**
February 2020	CS – Prepare for GC Interim Review (↻) 2/13/2020	Award the WTP Finished Water Pump Improvements Contract CS – GC Interim Review (↻) 2/27/2020	*(Tentative) OC Appointees to the OWASA Board meet with Members of Orange County BOCC (TBD)*

OWASA Board of Directors – 12 Month Board Meeting Schedule (October 18, 2019)

Month	Board Meetings		Committee & Other Meetings
	Work Session	Business Meeting	
March 2020	FY 21 Draft Budget & Rates **Forest Management Program Update** Award the WTP Water Mains Resiliency Contract (Tentative) Update on New Water Main Prioritization Model CS – Prepare for ED Interim Review 3/12/2020	Set date for Public Hearings – FY 21 Budget & Rates **Annual Update of the Energy Management Plan** FY 21 Draft Budget & Rates and Proposed Staff Rate Adjustment Recommendation Award the Bolinwood Drive Interceptor Contract CS – ED Interim Review 3/26/2020	
April 2020	Review Employee Health and Dental Insurance Renewals FY 21 Draft Budget and Rate Adjustment Information 4/9/2020	Q3 Financial Report 4/23/2020	
May 2020	Approve Employee Health and Dental Insurance Renewals Discuss Employee Merit Pay for FY 21 Diversity and Inclusion Update **(Tentative) LRWSP – Final Evaluation of Water Supply and Demand Management Alternatives** 5/14/2020	Public Hearings – FY 21 Budget and Rates Award the University Lake Permanganate Facility Contract 5/28/2020	
June 2020	Approve FY 21 Budget and Rates, including merit pay decision Election of Officers 6/11/2020	TBD 6/25/2020	
July 2020	**(Tentative) LRWSP – draft LRWSP** 7/9/2020	TBD 7/23/2020	
August 2020	CS – Prepare for GC Annual Review 8/13/2020	Preliminary 12 Month Financial Report CIP Semiannual Report CS – GC Annual Review 8/27/2020	
September 2020	EEO/Affirmative Action Report & Diversity and Inclusion Update Annual Report on Disposal of Surplus Personal Property **Forest Management Update** CS – Prepare for ED Annual Review 9/10/2020	Annual Report and Financial Audit Approve General Counsel Engagement CS – ED Annual Review 9/24/2020	

Note: Meetings related to new ED search and selection will be scheduled. Additional Finance Committee meetings will likely be needed related to improving the budgeting process.

The 12 Month Board Meeting Schedule shows Strategic Plan initiatives and other priority efforts that the Board and staff plan to give greatest consideration to during the next twelve months. The schedule also shows major recurring agenda items that require Board action, or items that have been scheduled in response to the Board's prior standing request. This schedule does not show all the items the Board may consider in a work session or business meeting. It also does not reflect meetings at which the Board will discuss and act on the update of the Strategic Plan.

The 12 Month Board Meeting Schedule will be reviewed and updated at each monthly work session and may also be discussed and updated at the Board's business meetings.

In addition to the initiatives shown in this schedule, staff will be working on other Strategic Plan and organizational priorities that are not expected to require major additional discussion with the Board except as part of budget deliberations.

OWASA Board of Directors – 12 Month Board Meeting Schedule (October 18, 2019)

The schedule implies that the following Strategic Plan initiatives would be addressed beyond the 12-month period. The Board may conclude that one or more of the following initiatives are higher priority. The schedule will be revised as needed to reflect the Board's priorities, and any additional initiatives that the Board may decide to address.

- Development of a plan and policy framework for OWASA lands is considered a longer-term priority. The NRTS Committee discussed this issue in September 2017 and determined it was lower priority than Forest Management.
- Water Conservation Plan will be prepared concurrent with update of the Long-Range Water Supply Plan.
- Update of Strategic Plan. On November 15, 2018, the Board and staff agreed to defer update of the Strategic Plan to a date to be determined.

The OWASA Board determines which topics it wants to explore as a full Board (potentially in a work session format) and which topics it wants to assign to Board committees or committee chairs for further analysis and development of recommendations. Board also determines priorities and desired timeframes for addressing topics. Committee meetings will be updated on the schedule routinely.

Abbreviations Used in Draft Schedule:

↻	Recurring agenda item (generally these are "required" items)
AV/AMI	Agua Vista/Advanced Metering Infrastructure
BOCC	Board of County Commissioners
CBOA	Carrboro Board of Aldermen
CE	Community Engagement
CEP	Community Engagement Plan
CHTC	Chapel Hill Town Council
CIP	Capital Improvements Program
COLA	Cost of Labor Adjustment
CS	Closed Session of the Board
CY	Calendar Year
D&I	Diversity and Inclusion
ED	Executive Director
EEO	Equal Employment Opportunity
FY	Fiscal Year
GC	General Counsel
HR	Human Resources
JLP	Jordan Lake Partnership
KPI	Key Performance Indicator
LRWSP	Long-Range Water Supply Plan
MOA	Memorandum of Agreement
MWBE	Minority/Women-owned Business Enterprises
MST	Mountains-to-Sea Trail
MFMM	Multi-Family Master Meter
NCDOT	North Carolina Department of Transportation
NRTS	Natural Resources and Technical Services
OC	Orange County
Q	Quarter
RFP	Request for Proposals
SRF	State Revolving Fund
SOW	Scope of Work
TBD	To Be Determined
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Orange Water and Sewer Authority

Closed Session of the Board of Directors

October 10, 2019

The Board of Directors of Orange Water and Sewer Authority met in Closed Session in on Thursday, October 10, 2019, following the Board meeting.

Board Members present: Ray DuBose (Chair), Ruchir Vora (Vice Chair), Bruce Boehm (Secretary), Yinka Ayankoya, John Cooley, Jody Eimers, Robert Morgan, John N. Morris and Bruce Runberg.

Staff present: Ed Kerwin.

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Item One

The Board of Directors met in Closed Session with staff to evaluate Executive Director's annual performance review.

No official action was taken at the meeting.

The meeting was adjourned at 8:07 p.m.

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Robert Morgan, Chair
Human Resources Committee

Agenda Item

- Adopt Series Resolutions for Series 2019 Revenue Bonds and Series 2020 Revenue Refunding Bonds

Purpose

- To seek Board approval of the Series Resolutions related to the issuance of the Series 2019 Water and Sewer Revenue Bonds and Series 2020 Revenue Refunding Bonds.

Background

- On September 26, 2019, the Board approved resolutions to apply to the North Carolina Local Government Commission for approval of issuing revenue bonds and revenue refunding bonds.

- Proceeds from the Series 2019 revenue bonds will be used to fund about $18.4 million in capital improvements program projects.

- The Series 2020 refunding bonds will replace currently outstanding bonds at a lower interest rate. We estimate that the refunding will save about $1.2 million over the next six years.

- To be able to proceed with issuing the bonds, the Series Resolutions for each bond series must be adopted by the Board.

Action Needed

- Approve the Series Resolutions.

October 24, 2019

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

MEMORANDUM

TO: Board of Directors

THROUGH: Ed Kerwin

FROM: Stephen Winters, CPA

DATE: September 18, 2019

SUBJECT: Adopt Series Resolutions for Series 2019 Revenue Bonds and Series 2020 Revenue Refunding Bonds

Background

On September 26, 2018, the Board approved a resolution to apply to the North Carolina Local Government Commission for approval of issuing revenue bonds to raise money to fund about $18.4 million in capital improvements projects and revenue refunding bonds to reduce interest expense over the next six years.

Series 2019 Water and Sewer Revenue Bonds

Our long-term financial planning indicates the need to borrow about $26 million over the next two years. The state has committed to loaning us about $8.9 million in low-interest loans (1.89%) and we have identified another $18.4 million in Capital Improvements Program (CIP) projects to be funded by the Series 2019 Water and Sewer Revenue Bonds.

Series 2020 Water and Sewer Revenue Refunding Bonds

In our effort to address service affordability, we continually look for ways to reduce costs and/or risk. One of our practices is to regularly monitor the bond market and evaluate opportunities to reduce our interest costs. Based on current market conditions, we have an opportunity to potentially reduce interest costs and annual debt service obligations by refunding our outstanding Series 2010 Bonds.

The Series 2010 Bonds have roughly six years remaining until they will be paid in-full. Based on current market conditions, we estimate that we can reduce the total amount left to be paid by approximately $1.2 million or almost $200,000 per year: a net present value savings of about 11%. These estimates are net of the cost to issue the bonds.

The Series 2010 Bonds become eligible to be refunded in April 2020. To save transaction costs and to lock-in current interest rates, we plan to issue the new money bonds and the refunding

bonds at the same time. The refunding bonds will not officially close until April which is why they are named Series 2020. There is risk that interest rates may be lower in April 2020 than they will be when we lock-in rates in November 2019. However, given that rates are near historic lows, staff and our financial advisors believe this risk is acceptable.

Resolution

To be able to proceed with issuing the bonds, the attached Series Resolutions must be adopted by the Board. In accordance with Section 2.08 of OWASA's Bond Order dated September 13, 2001, the final formal action the Board of Directors must take to issue the refunding bonds is to adopt the Series 2019 and 2020 Bond Resolutions. The resolution has been prepared by OWASA's Bond Counsel, McGuireWoods LLP.

The resolution specifies the terms and conditions relating to the determination of the total amount of the bonds to be issued, as well as the maturity structures, interest rates, and call provisions on the bonds. They also delegate, subject to certain conditions, to the Board Chair, Vice-Chair, the Executive Director or Director of Finance and Customer Service the authority to approve the exact principal amounts, the interest rates on the bonds, the maturity dates, the redemption provisions, and related matters, and to execute all required legal documents relating to the closing of the bonds. Please note that the blanks appearing on certain pages are intentional and will be filled-in after pricing takes place.

Action Requested

Approve Series Resolutions

Stephen Winters, CPA
Director of Finance and Customer Service

Attachment: Series Resolutions

SERIES RESOLUTION OF THE ORANGE WATER AND SEWER AUTHORITY RELATING TO THE ISSUANCE OF NOT EXCEEDING $20,000,000 WATER AND SEWER SYSTEM REVENUE BONDS, SERIES 2019 OF SAID AUTHORITY PURSUANT TO THE PROVISIONS OF SECTION 2.08 OF AN AMENDED AND RESTATED BOND ORDER ADOPTED BY SAID AUTHORITY ON SEPTEMBER 13, 2001, AS AMENDED, AND REQUESTING THE LOCAL GOVERNMENT COMMISSION OF NORTH CAROLINA TO AWARD SAID BONDS AT PRIVATE SALE

WHEREAS, the Orange Water and Sewer Authority ("OWASA"), a public body and body politic and corporate of the State of North Carolina, is authorized under the provisions of the North Carolina Water and Sewer Authorities Act, as amended, and The State and Local Government Revenue Bond Act, as amended (collectively, the "Act"), to acquire, lease, construct, reconstruct, improve, extend, enlarge, equip, repair, maintain and operate water and sewer systems or any part thereof within Orange County, North Carolina, to issue revenue bonds of OWASA to pay the cost of such water and sewer systems and to issue revenue refunding bonds; and

WHEREAS, OWASA has heretofore issued (a) $21,645,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2010, which are currently outstanding in the principal amount of $12,185,000, (b) $15,695,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2014, which are currently outstanding in the principal amount of $13,375,000, and (c) $8,995,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2015, which are currently outstanding in the principal amount of $1,420,000, and (d) $18,075,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2018, all of which are currently outstanding, pursuant to the Act and an amended and restated bond order adopted on September 13, 2001, as amended by a supplemental order adopted on October 28, 2010 (the Amended and Restated Bond Order, and any orders supplemental thereto and amendatory thereof, being hereinafter referred to as the "Order"); and

WHEREAS, Section 2.08 of the Order authorizes the issuance of additional revenue bonds of OWASA in one or more series from time to time for the purpose of providing funds for paying, with any other available funds, all or any part of the Cost of any Additional Project (as defined in the Order) and all or any part of completing payment of the Cost of the Project (as defined in the Order) and any Additional Project; and

WHEREAS, OWASA has determined that it is necessary to acquire and construct a certain Additional Project which is described in Appendix A to this Series Resolution (the "2019 Project"), which constitutes an Additional Project under the Order, and to pay a portion of the cost of the 2019 Project by issuing an additional series of revenue bonds and using any other available funds as authorized by Section 2.08 of the Order; and

WHEREAS, OWASA has determined that it will be able to satisfy the requirements of Section 2.08 of the Order with respect to the issuance of such series of revenue bonds; and

WHEREAS, pursuant to Section 2.08 of the Order, such series of revenue bonds is to have such terms and provisions as may be provided by a series resolution to be adopted by OWASA prior to the issuance thereof;

NOW, THEREFORE, THE ORANGE WATER AND SEWER AUTHORITY DOES HEREBY DETERMINE AND RESOLVE, as follows:

Section 1. Definitions. Unless otherwise required by the context, capitalized words and terms used in this Resolution (this "Series Resolution") and not otherwise defined herein shall have the same meanings in this Series Resolution as such words and terms are given in the Order, and the following words and terms shall have the following meanings:

"Bond Registrar" means The Bank of New York Mellon Trust Company, N.A. as designated by Section 2 of this Series Resolution, or any successor.

"Bond Year" means the period commencing on June 1 of any year and ending on May 31 of the following year.

"Business Day" means a day on which the Trustee, the Bond Registrar and the New York Stock Exchange are open for the purpose of conducting their businesses.

"Closing" means the delivery of and payment for the Series 2019 Bonds.

"Closing Date" means the date of the Closing.

"Electronic Means" means the following communication methods: e-mail; facsimile transmission; secure electronic transmission containing applicable authorization codes; passwords and/or authentication keys; or another method or system specified by the Trustee as available for use in connection with its services as Trustee under this Series Resolution.

"Interest Payment Date" means June 1, 2020, and each December 1 and June 1 thereafter, to and including the final maturity date of the Series 2019 Bonds.

"MSRB" means the Municipal Securities Rulemaking Board.

"Regular Record Date" means the 15th day of the month preceding any Interest Payment Date, whether or not a Business Day.

"Securities Depository" means The Depository Trust Company, New York, New York, or other recognized securities depository selected by OWASA, which maintains a book-entry system in respect of the Series 2019 Bonds, and shall include any substitute for or successor to the securities depository initially acting as Securities Depository.

"Securities Depository Nominee" means, as to any Securities Depository, such Securities Depository or the nominee of such Securities Depository in whose name there shall be registered on the registration books maintained by the Bond Registrar the Series 2019 Bond certificates to be delivered to such Securities Depository or its custodian

during the continuation with such Securities Depository of participation in its book-entry system.

"Series Certificate" shall have the meaning given to such term by Section 4 of this Series Resolution.

"Series 2019 Additional Project Account" means the account in the Construction Fund created and so designated by Section 5 of this Series Resolution.

"Series 2019 Bonds" means OWASA's Water and Sewer System Revenue Bonds, Series 2019.

"Series 2019 Subaccount of the Interest Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Series 2019 Subaccount of the Principal Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Series 2019 Subaccount of the Redemption Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Series 2019 Subaccount of the Sinking Fund Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Sinking Fund Requirement" means, with respect to the Series 2019 Bonds that are Term Bonds, if any, for any Bond Year, the principal amount fixed or computed for retirement by purchase or redemption on or prior to June 1 of the following Bond Year.

The Sinking Fund Requirements shall be initially the respective principal amounts set forth in the Series Certificate.

The aggregate amount of such Sinking Fund Requirements for the Term Bonds, together with the amount due upon the final maturity of such Term Bonds, shall be equal to the aggregate principal amount of the Term Bonds. The Sinking Fund Requirements for the Term Bonds shall begin in the Bond Year determined as provided in the Series Certificate and shall end with the Bond Year immediately preceding the maturity of such Term Bonds (such final installment being payable at maturity and not redeemed). Any principal amount of Term Bonds retired by operation of the Series 2019 Subaccount of the Sinking Fund Account by purchase in excess of the total amount of the Sinking Fund Requirement for such Term Bonds, to and including such June 1, shall be credited against and reduce the future Sinking Fund Requirements for such Term Bonds in such manner as shall be specified in an Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution.

On or before the 45th day next preceding any June 1 on which Term Bonds are to be retired pursuant to the Sinking Fund Requirement, OWASA may deliver to the Trustee for cancellation Term Bonds required to be redeemed on such June 1 in any aggregate principal amount desired and receive a credit against amounts required to be transferred from the Series 2019 Subaccount of the Sinking Fund Account on account of such Term Bonds in the amount of

100% of the principal amount of any such Term Bonds so purchased. Any principal amount of Term Bonds purchased by the Trustee and cancelled in excess of the principal amount required to be redeemed on such June 1, shall be credited against and reduce the principal amount of future Sinking Fund Requirements in such manner as shall be specified in an Officer's Certificate in substantially the form of the Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution.

It shall be the duty of the Trustee, on or before the 15th day of July in each Bond Year, to recompute, if necessary, the Sinking Fund Requirement for such Bond Year and all subsequent Bond Years for the Term Bonds Outstanding based on the Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution. The Sinking Fund Requirement for such Bond Year as so recomputed shall continue to be applicable during the balance of such Bond Year and no adjustment shall be made therein by reason of Term Bonds purchased or redeemed or called for redemption during such Bond Year.

If any Term Bonds are paid or redeemed by operation of the Series 2019 Subaccount of the Redemption Account, the Trustee shall reduce future Sinking Fund Requirements therefor in such manner as shall be specified in an Officer's Certificate in substantially the form of the Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution.

Section 2. Authorization of the Series 2019 Bonds Pursuant to the Order. (A) Series 2019 Bonds. Pursuant to the Act and Section 2.08 of the Order, OWASA hereby authorizes the issuance of revenue bonds of OWASA, designated "Orange Water and Sewer Authority Water and Sewer System Revenue Bonds, Series 2019" (the "Series 2019 Bonds") in an aggregate principal amount not exceeding $20,000,000, for the purpose of providing funds, together with any other available funds, to (1) pay of the Cost of the 2019 Project and (2) pay certain fees and expenses incurred in connection with the sale and issuance of the Series 2019 Bonds. Each Series 2019 Bond shall be dated the date of its delivery.

(B) Bond Provisions. The Series 2019 Bonds may consist of Serial Bonds and Term Bonds, shall bear interest at the rates, and shall mature, subject to any optional and mandatory sinking fund redemption, in the amounts and on the dates, all as hereinafter provided.

(C) Details; Interest Payment Dates. The Series 2019 Bonds shall be numbered consecutively from 2019-1 upward, shall be in the denomination of five thousand dollars ($5,000) and integral multiples thereof and shall be registered and exchangeable, and the transfer thereof may be registered, all in accordance with the provisions of the Order. Interest on the Series 2019 Bonds shall be payable semiannually on each June 1 and December 1, commencing on June 1, 2020, until the maturity thereof.

(D) Book-Entry. The Series 2019 Bonds shall be issued by means of a book-entry system with no physical distribution of bond certificates to be made except as hereinafter provided. One bond certificate with respect to each date on which the Series 2019 Bonds are stated to mature, in the aggregate principal amount of the Series 2019 Bonds stated to mature on such date and registered in the name of Cede & Co., as nominee of The Depository Trust Company ("DTC"), will be issued and required to be deposited with DTC or its custodian. The book-entry system will evidence ownership of the Series 2019 Bonds in the principal amount of

$5,000 or any multiple thereof, with transfers of ownership effected on the records of DTC and its participants pursuant to rules and procedures established by DTC and its participants. The principal of and any redemption premium on each Series 2019 Bond and interest with respect thereto shall be payable to Cede & Co., or any other person appearing on the registration books maintained by the Bond Registrar, as the registered owner of such Series 2019 Bond or its registered assigns or legal representatives. Transfer of principal, interest and any redemption premium payments to participants of DTC will be the responsibility of DTC, and transfer of principal, interest and any redemption premium payments to beneficial owners of the Series 2019 Bonds by participants of DTC will be the responsibility of such participants and other nominees of such beneficial owners. OWASA, the Bond Registrar and the Trustee shall not be responsible or liable for such transfers of payments or for maintaining, supervising or reviewing records maintained by DTC, its participants or persons acting through such participants.

In the event that (a) DTC determines not to continue to act as Securities Depository for the Series 2019 Bonds or (b) OWASA determines that continuation of the book-entry system of evidence and transfer of ownership of the Series 2019 Bonds would adversely affect the interests of the beneficial owners of the Series 2019 Bonds, OWASA shall discontinue the book-entry system with DTC. If OWASA identifies another qualified Securities Depository to replace DTC, OWASA shall make arrangements with DTC and such other Securities Depository to effect such replacement and deliver replacement Series 2019 Bonds registered in the name of such other Securities Depository or its Securities Depository Nominee in exchange for the outstanding Series 2019 Bonds, and the references to DTC or Cede & Co. in this Series Resolution shall thereupon be deemed to mean such other Securities Depository or its Securities Depository Nominee. If OWASA fails to identify another qualified Securities Depository to replace DTC, OWASA shall deliver replacement Series 2019 Bonds in the form of fully registered certificates in the denomination of $5,000 or any multiple thereof in exchange for the outstanding Series 2019 Bonds as required by DTC. The transferor shall, in connection with any transfer of Series 2019 Bonds outside the book-entry system, including, but not limited to, on or prior to the initial transfer of Series 2019 Bonds outside the book-entry system, provide or cause to be provided to the Trustee all information necessary to allow the Trustee to comply with any applicable tax reporting obligations, including without limitation any cost basis reporting obligations under Section 6045 of the Code. The Trustee may rely on the information provided to it and shall have no responsibility to verify or ensure the accuracy of such information.

(E) Bond Registrar. The Bank of New York Mellon Trust Company, N.A. is hereby appointed Bond Registrar for the Series 2019 Bonds.

Section 3. Delegation and Standards. OWASA hereby delegates to the Chair, the Vice-Chair, the Executive Director or the Director of Finance and Customer Service of OWASA, subject to the limitations contained herein, the power to determine and carry out the following with respect to the Series 2019 Bonds:

(A) Principal Amount. To determine the aggregate principal amount of the Series 2019 Bonds, such principal amount, not to exceed $20,000,000, to be sufficient for the purposes described in Section 2(A) of this Series Resolution;

(B) Interest Rates. To determine the interest rate or rates on the Series 2019 Bonds, no such rate to exceed five percent (5.00%) per annum;

(C) Maturities and Maturity Amounts. To determine the maturities and maturity amounts of the Series 2019 Bonds, no such maturity to extend beyond June 1, 2044;

(D) Serial and Term Bonds. To determine which Series 2019 Bonds are Serial Bonds, if any, and which Series 2019 Bonds are Term Bonds, if any, and the Sinking Fund Requirements for any such Term Bonds;

(E) Redemption Provisions. To determine the optional redemption provisions for the Series 2019 Bonds; provided, however, that the Series 2019 Bonds shall be made callable not later than 10 ½ years from their date and that the redemption price shall not exceed 103% of the face amount of the Series 2019 Bonds to be redeemed;

(F) Date of Sale. To determine the date of the sale of the Series 2019 Bonds;

(G) Negotiated Sale. To approve the sale of the Series 2019 Bonds in a negotiated sale in accordance with the provisions of Section 15 of this Series Resolution; provided, however, that the true interest cost for the Series 2019 Bonds shall not exceed four percent (4.00%) per annum and, provided further, that the price for the Series 2019 Bonds shall not be less than ninety-nine percent (99.00%) of the par amount of the Series 2019 Bonds, less the amount of original issue discount, if any, plus the amount of original issue premium on the Series 2019 Bonds, if any; and

(H) Other Provisions. To determine any other provisions deemed advisable and not in conflict with the provisions of this Series Resolution or the Order.

Section 4. Series Certificate. The Chair, the Vice-Chair, the Executive Director or the Director of Finance and Customer Service of OWASA shall execute a certificate or certificates (collectively, the "Series Certificate") evidencing the determinations or other actions taken by him pursuant to the authority granted in this Series Resolution, and any such Series Certificate shall be conclusive evidence of the action taken.

Section 5. Establishment of Account and Subaccounts. The following accounts and subaccounts are hereby established:

(a) Series 2019 Subaccount of the Interest Account;

(b) Series 2019 Subaccount of the Principal Account;

(c) Series 2019 Subaccount of the Redemption Account;

(d) Series 2019 Subaccount of the Sinking Fund Account; and

(e) Orange Water and Sewer Authority Water and Sewer System Revenue Bonds, Series 2019 Additional Project Account.

The account and subaccounts mentioned above shall be established with and held by the Trustee pursuant to the Order and this Series Resolution.

Section 6. Sinking Fund Redemption Provisions for the Series 2019 Bonds. The Series 2019 Bonds that are Term Bonds, if any, shall be subject to mandatory redemption in part on each June 1, as specified in the Series Certificate required by Section 4 of this Series Resolution.

Money held in the Series 2019 Subaccount of the Sinking Fund Account shall be applied during each Bond Year to the purchase or retirement of Term Bonds then Outstanding as follows:

(a) The Trustee shall, at the written request of OWASA, endeavor to purchase and cancel Term Bonds or portions thereof subject to redemption by operation of the Series 2019 Subaccount of the Sinking Fund Account or maturing on the next ensuing June 1 at the most advantageous price obtainable with reasonable diligence. The purchase price of each such Term Bond shall not exceed par plus accrued interest to the date of purchase. The Trustee shall pay the interest accrued on such Term Bonds to the date of settlement therefor from the Series 2019 Subaccount of the Interest Account or other funds provided by OWASA and the balance of the purchase price from the Series 2019 Subaccount of the Sinking Fund Account, but no such purchase shall be made by the Trustee from money in the Series 2019 Subaccount of the Sinking Fund Account within the period of forty-five (45) days immediately preceding any June 1 on which such Term Bonds are subject to redemption. The aggregate purchase price of Term Bonds, exclusive of accrued interest, during such Bond Year shall not exceed the amount deposited in the Series 2019 Subaccount of the Sinking Fund Account on account of the Sinking Fund Requirement for the Term Bonds for such Bond Year. If in any Bond Year the sum of the amount on deposit in the Series 2019 Subaccount of the Sinking Fund Account for the payment of any Term Bonds and the principal amount of the Term Bonds that were purchased during such Bond Year pursuant to the provisions of this paragraph (a) or delivered during such Bond Year to the Trustee by OWASA exceeds the Sinking Fund Requirement for the Outstanding Term Bonds for such Bond Year, the Trustee shall endeavor to purchase Outstanding Term Bonds with such excess money; and

(b) The Trustee shall call for redemption on June 1 immediately following the then current Bond Year the Term Bonds then subject to redemption in a principal amount equal to the aggregate Sinking Fund Requirement for the Term Bonds for such Bond Year, less the principal amount of any such Term Bonds retired during such Bond Year by purchase pursuant to paragraph (a) of this Section or delivered during such Bond Year to the Trustee by OWASA. If such June 1 is the stated maturity date of any such Term Bonds, the Trustee shall not call such Term Bonds for redemption but, on such maturity date, shall withdraw from the Sinking Fund Account and, not later than 10:00 A.M. on such date, remit by wire transfer to the Bond Registrar, in Federal Reserve or other immediately available funds, the amount required for paying the principal of such Term Bonds when due and payable. Not later than 10:00 A.M. on each such redemption date, the Trustee shall withdraw from the Series 2019 Subaccount of the Sinking Fund Account and remit by wire transfer to the Bond Registrar, in Federal Reserve or other immediately available funds, the respective amounts required for paying the Redemption Price of the Term Bonds or portions thereof so called for redemption.

If, in any Bond Year, by the application of money in the Series 2019 Subaccount of the Sinking Fund Account, the Trustee should purchase or receive from OWASA and cancel Term Bonds in excess of the aggregate Sinking Fund Requirement for such Bond Year, the Trustee shall file with OWASA not later than the twentieth (20th) day prior to the next June 1 on which Term Bonds are to be redeemed, a statement identifying the Term Bonds purchased or delivered during such Bond Year and the amount of such excess. OWASA shall thereafter cause an Officer's Certificate to be filed with the Trustee not later than the tenth (10th) day prior to such June 1, setting forth with respect to the amount of such excess the Bond Years in which the Sinking Fund Requirements with respect to Term Bonds are to be reduced and the amount by which the Sinking Fund Requirements so determined are to be reduced.

Upon the retirement of any Term Bonds by purchase or redemption pursuant to the provisions of this Section, the Trustee shall file with OWASA a statement identifying such Term Bonds and setting forth the date of purchase or redemption, the amount of the purchase price or the Redemption Price of such Term Bonds, and the amount paid as interest thereon. The expenses incurred in connection with the purchase or redemption of any such Term Bonds shall be paid by OWASA as Current Expenses or from any other available moneys.

Section 7. Selection of Series 2019 Bonds for Redemption. The Series 2019 Bonds shall be redeemed only in whole multiples of five thousand dollars ($5,000). If less than all of the Series 2019 Bonds are to be called for redemption, the Series 2019 Bonds to be so redeemed shall be called for redemption in the manner that OWASA shall determine as set forth in an Officer's Certificate filed with the Trustee.

If less than all of the Series 2019 Bonds of any one maturity are called for redemption, the Bond Registrar shall select the Series 2019 Bonds to be redeemed by lot, each five thousand dollar ($5,000) portion of principal being counted as one Series 2019 Bond for this purpose; provided, however, that so long as the only registered owner of the Series 2019 Bonds is a Securities Depository Nominee, such selection shall be made by the Securities Depository.

Section 8. Redemption Notice. Not less than thirty (30) days but not more than sixty (60) days prior to the redemption date of any Series 2019 Bonds to be redeemed, whether such redemption be in whole or in part, the Bond Registrar shall cause a notice of any such redemption signed by the Bond Registrar to be mailed, first class, postage prepaid, to all Owners of Series 2019 Bonds to be redeemed in whole or in part, provided that notice to any Securities Depository shall be sent by Electronic Means if so required or requested by such Securities Depository and provided further that failure to give any such notice to any Owner or any defect in such notice shall not affect the validity of the proceedings for such redemption as to the Series 2019 Bonds of any other Owner to whom such notice has been properly given. Not less than thirty (30) days prior to the date of redemption, the Bond Registrar shall also give such notice of redemption to (A) the MSRB through its Electronic Municipal Market Access (EMMA) system, and (B) the North Carolina Local Government Commission by first class mail, postage prepaid, but failure to give such notice or any defect therein shall not affect the validity of any proceedings for the redemption of any Series 2019 Bonds. Notwithstanding anything to the contrary herein, OWASA acknowledges and agrees that the Bond Registrar is not acting as the disclosure/dissemination agent for purposes of Rule 15c2-12 (as defined herein) in connection

with any notice required to be posted with the MSRB via its Electronic Municipal Marketplace Access (EMMA) system.

Each such notice shall set forth the designation and date of the Series 2019 Bonds, the CUSIP numbers of the Series 2019 Bonds to be redeemed, the date fixed for redemption, the Redemption Price to be paid, the address and phone number of the Trustee and Bond Registrar, the date of the redemption notice, the maturities of the Series 2019 Bonds to be redeemed and, if less than all of the Series 2019 Bonds of any one maturity then Outstanding shall be called for redemption, the distinctive numbers and letters, if any, of such Series 2019 Bonds to be redeemed and, in the case of Series 2019 Bonds to be redeemed in part only, the portion of the principal amount thereof to be redeemed. If any Series 2019 Bond is to be redeemed in part only, the notice of redemption shall also state also that on or after the redemption date, upon surrender of such Series 2019 Bond, a new Series 2019 Bond in principal amount equal to the unredeemed portion of such Series 2019 Bond will be issued.

Any notice of redemption (other than a notice given with respect to a mandatory sinking fund redemption) may state that the redemption to be effected is conditioned upon the receipt by the Trustee or Bond Registrar, on or prior to the redemption date, of moneys sufficient to pay the Redemption Price of and interest on the Series 2019 Bonds to be redeemed and that if such moneys are not so received such notice shall be of no force or effect and such Series 2019 Bonds shall not be required to be redeemed. In the event that such notice contains such a condition and moneys sufficient to pay the Redemption Price of and interest on such Series 2019 Bonds are not received by the Trustee or Bond Registrar on or prior to the redemption date, the redemption shall not be made and the Bond Registrar shall within a reasonable time thereafter give notice, in the manner in which the notice of redemption was given, that such moneys were not so received.

Section 9. Series 2019 Subaccount of the Redemption Account. The Trustee shall apply money in the Series 2019 Subaccount of the Redemption Account to the purchase or redemption of Series 2019 Bonds as follows:

(a) Subject to the provisions of paragraph (c) of this Section, upon the written request of OWASA, the Trustee shall endeavor to purchase and cancel Series 2019 Bonds or portions thereof, regardless of whether such Series 2019 Bonds or portions thereof are then subject to redemption, at the most advantageous price obtainable with reasonable diligence, provided that the purchase price of each Series 2019 Bond shall not exceed the Redemption Price that would be payable on the next redemption date to the Owner of such Series 2019 Bond under the provisions of the Series Certificate. The Trustee shall pay the interest accrued on such Series 2019 Bonds or portions thereof to the date of settlement from the Series 2019 Subaccount of the Interest Account or other funds provided by OWASA and the balance of the purchase price from the Series 2019 Subaccount of the Redemption Account, but no such purchase shall be made by the Trustee from money in the Series 2019 Subaccount of the Redemption Account within the period of forty-five (45) days immediately preceding any date on which such Series 2019 Bonds or portions thereof are to be redeemed.

(b) Subject to the provisions of paragraph (c) of this Section, the Trustee shall call for redemption on a date permitted by this Series Resolution and the Series Certificate such amount of Series 2019 Bonds or portions thereof as, with the redemption premium, if any, will exhaust

the money then held in the Series 2019 Subaccount of the Redemption Account as nearly as may be practicable; provided, however, that not less than Fifty Thousand Dollars ($50,000) in principal amount of the Series 2019 Bonds shall be called for redemption at any one time unless the Trustee is so instructed in writing by OWASA. The Trustee shall pay the accrued interest on the Series 2019 Bonds or portions thereof to be redeemed to the date of redemption from the Series 2019 Subaccount of the Interest Account or other funds provided by OWASA and the Redemption Price of such Series 2019 Bonds or portions thereof from the Series 2019 Subaccount of the Redemption Account. The Trustee shall withdraw from the Series 2019 Subaccount of the Redemption Account and set aside the amount required to pay the Redemption Price of the Series 2019 Bonds or portions thereof so called for redemption.

(c) Money in the Series 2019 Subaccount of the Redemption Account shall be applied by the Trustee in each Fiscal Year to the purchase or the redemption of Series 2019 Bonds then Outstanding in accordance with the latest Officer's Certificate filed with the Trustee designating the Series 2019 Bonds to be redeemed. In the event no such certificate is filed (i) the Trustee shall apply such money to the purchase of Series 2019 Bonds bearing the highest rate of interest, (ii) if Series 2019 Bonds of more than one maturity bear the same interest rate, the Trustee shall redeem such Series 2019 Bonds in the inverse order of maturities, and (iii) if the Series 2019 Bonds bearing the highest rate of interest are Term Bonds, the Trustee shall reduce the Sinking Fund Requirements for such Term Bonds in inverse order of the scheduled redemption of such Term Bonds.

Upon the retirement of any Series 2019 Bonds by purchase or redemption pursuant to the provisions of this Section, the Trustee shall file with OWASA a statement identifying such Series 2019 Bonds and setting forth the date of purchase or redemption, the amount of the purchase price or the Redemption Price of such Bonds and the amount paid as interest thereon. The expenses incurred by the Trustee in connection with the purchase or redemption of any such Series 2019 Bonds shall be paid by OWASA from the Revenue Account as Current Expenses or from any other available moneys.

Section 10. Form of Series 2019 Bond. The Series 2019 Bonds and the Certificate of the North Carolina Local Government Commission and the Certificate of Authentication to be endorsed on all the Series 2019 Bonds shall be substantially in the following forms, with such variations, omissions and insertions as are required or permitted by the Order or this Series Resolution:

[Form of Series 2019 Bond]

No. R2019-__ $_____

United States of America
State of North Carolina

ORANGE WATER AND SEWER AUTHORITY

Water and Sewer System Revenue Bond,
Series 2019

Maturity Date	Dated Date	Interest Rate	CUSIP
June 1, 20__	_____ __, 2019	___%	_____

Principal Amount: _____ DOLLARS ($_____)

Registered Owner:

The Orange Water and Sewer Authority (the "Authority"), a public body and body politic and corporate of the State of North Carolina, is justly indebted and for value received hereby promises to pay, solely from the sources and in the manner hereinafter set forth, to the Registered Owner shown above or registered assigns or legal representative, on the maturity date specified above (or earlier as stated hereinafter), upon the presentation and surrender hereof at the corporate trust office of The Bank of New York Mellon Trust Company, N.A., in East Syracuse, New York, or any successor bond registrar (the "Bond Registrar"), the principal amount shown above, and to pay, solely from such sources, to the person in whose name this bond (or one or more Predecessor Bonds, as defined in the Order hereinafter mentioned) is registered at the close of business on the regular record date for such interest, which shall be the 15th day of the calendar month next preceding an interest payment date (the "Regular Record Date"), interest on this bond from the interest payment date next preceding the date on which it is authenticated, unless it is authenticated on an interest payment date, in which event it shall bear interest from such date, or it is authenticated prior to June 1, 2020, in which event it shall bear interest from its date, payable on June 1, 2020 and semiannually thereafter on December 1 and June 1 of each year, at the rate per annum specified above until the principal sum hereof is paid. Any such interest not so punctually paid shall forthwith cease to be payable to the person who was the registered owner on such Regular Record Date and may be paid to the person in whose name this bond (or one or more Predecessor Bonds) is registered at the close of business on a Special Record Date, as defined in the Order, for the payment of such defaulted interest to be fixed by the Trustee hereinafter mentioned, notice whereof being given to registered owners not more than fifteen (15) days and not less than ten (10) days prior to such Special Record Date, or may be paid in any other lawful manner not inconsistent with the requirements of applicable law or any securities exchange on which the bonds may be listed and upon such notice as may be required by such law or exchange, all as more fully provided in the Order. All such payments shall be made in the lawful money of the United States of America.

This bond is one of a duly authorized series of revenue bonds of the Authority, designated "Orange Water and Sewer Authority Water and Sewer System Revenue Bonds, Series 2019" (the "Series 2019 Bonds"), and issued for the purpose of providing funds, together with any other available funds, to (i) pay the cost of the 2019 Project (as defined in the hereinafter-defined Series Resolution) and (ii) pay certain fees and expenses incurred in connection with the sale and issuance of the Series 2019 Bonds.

The Series 2019 Bonds are being issued by means of a book-entry system with no physical distribution of bond certificates to be made except as provided in the Series Resolution. One Series 2019 Bond certificate with respect to each date on which the Series 2019 Bonds are stated to mature, registered in the name of the Securities Depository Nominee (as defined in the Series Resolution), is being issued and required to be deposited with the Securities Depository (as defined in the Series Resolution) or its custodian. The book-entry system will evidence positions held in the Series 2019 Bonds by the Securities Depository's participants, beneficial ownership of the Series 2019 Bonds in the principal amount of $5,000 or any integral multiple thereof being evidenced in the records of such participants. Transfers of ownership will be effected on the records of the Securities Depository and its participants pursuant to rules and procedures established by the Securities Depository and its participants. The Authority, the Bond Registrar and the Trustee will recognize the Securities Depository Nominee, while the registered owner of this Series 2019 Bond, as the owner of this Series 2019 Bond for all purposes, including (i) payments of principal of, and redemption premium, if any, and interest on, this Series 2019 Bond, (ii) notices and (iii) voting. Transfer of principal, interest and any redemption premium payments to participants of the Securities Depository will be the responsibility of the Securities Depository, and transfer of principal, interest and any redemption premium payments to beneficial owners of the Series 2019 Bonds by participants of the Securities Depository will be the responsibility of such participants and other nominees of such beneficial owners. The Authority, the Bond Registrar and the Trustee will not be responsible or liable for such transfers of payments or for maintaining, supervising or reviewing the records maintained by the Securities Depository, the Securities Depository Nominee, the Securities Depository's participants or persons acting through such participants. While the Securities Depository Nominee is the registered owner of this Series 2019 Bond, notwithstanding the provisions hereinabove contained, payments of principal of, redemption premium, if any, and interest on this Series 2019 Bond shall be made in accordance with existing arrangements between the Bond Registrar or its successors under the Series Resolution and the Securities Depository.

The Series 2019 Bonds are being issued under and pursuant to the Constitution and laws of the State of North Carolina, including the North Carolina Water and Sewer Authorities Act, as amended, and The State and Local Government Revenue Bond Act, as amended (collectively, the "Act"), an amended and restated bond order duly adopted by the Authority on September 13, 2001, as amended by a supplemental order adopted by the Authority on October 28, 2010 (said amended and restated bond order, together with all orders supplemental and amendatory thereto as therein permitted, being herein called the "Order") and a series resolution duly adopted by the Authority on October 24, 2019 (the "Series Resolution"). The Authority has heretofore issued and secured under the Order, $21,645,000 original aggregate principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2010, which are currently outstanding in the principal amount of $12,185,000 (the "Series 2010 Bonds"), $15,695,000 original aggregate

principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2014, which are currently outstanding in the principal amount of $13,375,000 (the "Series 2014 Bonds"), $8,995,000 original aggregate principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2015, which are currently outstanding in the principal amount of $1,420,000 (the "Series 2015 Bonds") and $18,075,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2018, all of which are currently outstanding (the "Series 2018 Bonds"). The Order provides for the issuance from time to time under the conditions, limitations and restrictions therein set forth of additional bonds to provide funds for paying all or any part of the cost of any Additional Project (as defined in the Order), to provide funds for completing payment of the cost of the Project (as defined in the Order) and any Additional Project, and to provide funds to pay the cost (including financing costs) of refunding any bonds issued under the Order, Parity Debt (as defined in the Order) or Subordinated Indebtedness (as defined in the Order) (such additional bonds, the Series 2019 Bonds, the Series 2018 Bonds, the Series 2015 Bonds, the Series 2014 Bonds and the Series 2010 Bonds being herein collectively called the "Bonds"). Copies of the Order and the Series Resolution are on file at the corporate trust office of The Bank of New York Mellon Trust Company, N.A. (the "Trustee") in Jacksonville, Florida. By the acceptance of this bond, the registered owner hereof assents to all of the provisions of the Order and the Series Resolution.

The Series 2019 Bonds are special obligations of the Authority secured by a pledge, charge and lien upon Net Receipts (as defined in the Order). The Authority is not obligated to pay the principal of or the interest on the Series 2019 Bonds except, as provided in the Order, from Net Receipts or certain other monies made available therefor under the Order, and neither the faith and credit nor the taxing power of the State of North Carolina or any political subdivision thereof or the Authority is pledged to the payment of the principal of and the interest on the Series 2019 Bonds. The Order provides for the issuance or incurrence from time to time under the conditions, limitations and restrictions therein set forth of Bonds and Parity Debt (as defined in the Order) secured on a parity as to the pledge of Net Receipts.

Reference is made to the Order and the Series Resolution for a more complete statement of the provisions thereof and of the rights of the Authority, the Trustee and the registered owners of the Series 2019 Bonds.

The Order provides for the creation of a special fund designated "Orange Water and Sewer Authority Water and Sewer System Revenue Bonds Bond Fund" (the "Bond Fund"). Pursuant to the Series Resolution, special subaccounts have been created within the various accounts of the Bond Fund with respect to the Series 2019 Bonds (the "Subaccounts"), which Subaccounts are pledged to and charged with the payment of the principal of and the interest on the Series 2019 Bonds. The Series Resolution also provides for the deposit of Net Receipts to the credit of the Subaccounts to the extent and in the manner provided in the Order and the Series Resolution.

The Series 2019 Bonds are issuable as registered bonds without coupons, in denominations of $5,000 or any integral multiple thereof. At the designated corporate trust office of the Bond Registrar, in the manner and subject to the limitations and conditions provided in the Order, Series 2019 Bonds may be exchanged for an equal aggregate principal amount of Bonds of the same maturity, of authorized denominations and bearing interest at the same rate.

The transfer of this bond is registrable by the registered owner hereof in person or by his attorney or legal representative at the designated corporate trust office of the Bond Registrar but only in the manner and subject to the limitations and conditions provided in the Order and upon surrender and cancellation of this bond. Upon any such registration of transfer the Authority shall execute and the Bond Registrar shall authenticate and deliver in exchange for this bond a new Series 2019 Bond or Series 2019 Bonds, registered in the name of the transferee, of authorized denominations, in aggregate principal amount equal to the principal amount of this bond, of the same maturity and bearing interest at the same rate. The Authority or the Bond Registrar may make a charge for every such exchange or registration of transfer of Series 2019 Bonds sufficient to reimburse it for any tax or other governmental charge required to be paid with respect to such exchange or registration of transfer, but no other charge shall be made to any registered owner for the privilege of exchanging or registering the transfer of Series 2019 Bonds. Neither the Authority nor the Bond Registrar shall be required to make any such exchange or registration of transfer of Series 2019 Bonds during the fifteen (15) days immediately preceding the date of first giving of notice of any redemption of Series 2019 Bonds or any portion thereof or of any Series 2019 Bond after such Series 2019 Bond or any portion thereof has been selected for redemption.

The Series 2019 Bonds maturing on or after June 1, 20__ are subject to redemption, at the option of the Authority, on or after June 1, 20__, in whole or in part (by lot within a maturity) at any time. Any such redemption will be at the redemption prices (expressed as a percentage of the principal amount of Series 2019 Bonds to be redeemed), plus accrued interest thereon to the redemption date, all as set forth in the following table:

Redemption Periods	Redemption Prices
June 1, 20__ through May 31, 20__	%
June 1, 20__ through May 31, 20__	
June 1, 20__ and thereafter	

The Series 2019 Bonds at the time outstanding that are stated to mature on June 1, 20__ are required to be redeemed in part by lot on June 1, 20__ and on each June 1 thereafter from moneys deposited with the Trustee for such purpose. Such redemption shall be at a redemption price equal to 100% of the principal amount of the Series 2019 Bonds to be redeemed, plus accrued interest thereon to the redemption date.

If less than all of the Series 2019 Bonds are to be called for redemption, the Series 2019 Bonds to be so redeemed shall be called for redemption in the manner that the Authority shall determine as set forth in an Officer's Certificate filed with the Trustee. If less than all of the Series 2019 Bonds of any one maturity are called for redemption, the Bond Registrar shall select the Series 2019 Bonds to be redeemed by lot, each $5,000 portion of principal being counted as one Series 2019 Bond for this purpose; provided, however, that so long as the only registered owner of the Series 2019 Bonds is the Securities Depository Nominee, such selection shall be made by the Securities Depository.

Not less than thirty (30) days but not more than sixty (60) days prior to the redemption date of any Series 2019 Bonds, either in whole or in part, the Bond Registrar shall cause a notice

of any such redemption, signed by the Bond Registrar, to be mailed, first-class, postage prepaid, to all registered owners of Series 2019 Bonds or portions of Series 2019 Bonds to be redeemed at their addresses as they appear on the registration books maintained by the Bond Registrar, but failure so to mail any such notice shall not affect the validity of the proceedings for such redemption as to any registered owners to whom such notice was given as so required. The Bond Registrar shall also cause a notice of any such redemption to be given to such other parties as provided in the Series Resolution. On the date designated for redemption, notice having been given as aforesaid, the Series 2019 Bonds or portions of Series 2019 Bonds so called for redemption shall become and be due and payable at the redemption price provided for the redemption of such Series 2019 Bonds or portions thereof on such date, and, if the moneys for payment of the redemption price and the accrued interest are held by the Bond Registrar, as provided in the Order, interest on such Series 2019 Bonds or portions thereof shall cease to accrue, such Series 2019 Bonds or portions thereof shall cease to be entitled to any benefit or security under the Order, and the registered owners thereof shall have no rights in respect of such Series 2019 Bonds or portions thereof except to receive payment of the redemption price thereof and the accrued interest so held by the Bond Registrar. If a portion of this bond shall be called for redemption, a new Series 2019 Bond or Series 2019 Bonds in principal amount equal to the unredeemed portion hereof will be issued to the registered owner upon surrender hereof.

With respect to any notice of redemption of Series 2019 Bonds (other than a notice given with respect to a mandatory sinking fund redemption), such notice may state that such redemption shall be conditional upon the receipt by the Trustee or the Bond Registrar, on or prior to the date fixed for such redemption, of moneys sufficient to pay the redemption price of and accrued interest on such Series 2019 Bonds to be redeemed, and that if such moneys shall not have been so received, said notice shall be of no force and effect and the Authority shall not be required to redeem such Series 2019 Bonds. In the event that such notice of redemption contains such a condition and such moneys are not so received, the redemption shall not be made and the Bond Registrar shall within a reasonable time thereafter give notice, in the manner in which the notice of redemption was given, that such moneys were not so received.

The registered owner of this bond shall have no rights to enforce the provisions of the Order or to institute action to enforce the covenants therein, or to take any action with respect to any event of default under the Order or to institute, appear in or defend any suit or other proceeding with respect thereto, except as provided in the Order.

In certain events, on the conditions, in the manner and with the effect set forth in the Order, the principal of all the Bonds and Parity Debt then outstanding under the Order may become or may be declared due and payable before the stated maturities thereof, together with the interest accrued thereon.

Modifications or alterations of the Order may be made by the Authority only to the extent and in the circumstances permitted by the Order.

As declared by the Act, this bond, subject only to the provisions for registration and registration of transfer stated herein and contained in the Order, is an investment security within the meaning of and for all the purposes of Article 8 of the Uniform Commercial Code of the State of North Carolina.

This bond is issued with the intent that the laws of the State of North Carolina shall govern its construction.

All acts, conditions and things required by the Constitution and laws of the State of North Carolina, the Order and the Series Resolution to happen, exist and be performed precedent to and in the issuance of this bond have happened, exist and have been performed as so required.

This bond shall not be valid or become obligatory for any purpose or be entitled to any benefit or security under the Order until this bond shall have been authenticated by the execution by the Bond Registrar of the certificate of authentication endorsed hereon.

IN WITNESS WHEREOF, the Orange Water and Sewer Authority has caused this bond to be signed by its Chair and its Secretary-Treasurer and the corporate seal of the Authority to be impressed hereon, all as of the ___ day of_____, 2019.

[Seal] ORANGE WATER AND SEWER AUTHORITY

By:_____
Chair

By:_____
Secretary-Treasurer

CERTIFICATE OF LOCAL GOVERNMENT COMMISSION

The issuance of the within bond has been approved under the provisions of The State and Local Government Revenue Bond Act of North Carolina.

_____
Secretary, Local Government Commission of North Carolina

CERTIFICATE OF AUTHENTICATION

This bond is one of the Bonds of the series designated therein and issued under the provisions of the within-mentioned Order and Series Resolution.

THE BANK OF NEW YORK MELLON TRUST COMPANY, N.A., as Bond Registrar

By:_____
Authorized Signatory

Date of authentication: _____

ASSIGNMENT

FOR VALUE RECEIVED the undersigned registered owner thereof hereby sells, assigns and transfers unto _____
_____
_____
[Please Print or Typewrite Name and Address of Transferee]

the within Bond and all rights thereunder and hereby irrevocably constitutes and appoints _____ attorney to register the transfer of said Bond on the books kept for registration thereof, with full power of substitution in the premises

Dated: _____

_____
NOTICE: The assignor's signature to this assignment must correspond with the name as it appears upon the face of the within Bond in every particular, without alteration or enlargement or any change whatever.

Signature Guaranteed:

_____
NOTICE: Signature must be guaranteed by an institution which is a participant in the Securities Transfer Agent Medallion program (STAMP) or similar program.

Section 11. Series 2019 Additional Project Account. On the Closing Date, OWASA shall deposit, or cause there to be deposited, the net proceeds of the Series 2019 Bonds to the credit of the Series 2019 Additional Project Account. The Series 2019 Additional Project Account shall be governed by the provisions of Article IV of the Order, and the moneys in the Series 2019 Additional Project Account shall be applied, together with any other available funds, to pay the Cost of the 2019 Project and to pay certain fees and expenses incurred in connection with the sale and issuance of the Series 2019 Bonds.

Section 12. Application of Net Receipts. On or before the dates set forth below, OWASA shall, subject to the provisions of the Order, deposit or cause to be deposited, from Net Receipts held in the Revenue Account, with the Trustee the following amounts, and the Trustee shall apply such amounts to the various subaccounts and account specified in this Series Resolution in the following order:

(a) into the Series 2019 Subaccount of the Interest Account, on the Business Day immediately preceding each Interest Payment Date, an amount equal to the interest payable on the Series 2019 Bonds on such Interest Payment Date;

(b) into the Series 2019 Subaccount of the Principal Account, on the Business Day immediately preceding each June 1, beginning in the year specified in the Series Certificate, an amount equal to the principal of all Series 2019 Bonds that are Serial Bonds, if any, due on such June 1; and

(c) into the Series 2019 Subaccount of the Sinking Fund Account, on the Business Day immediately preceding each June 1, beginning in the year specified in the Series Certificate, the amount required to retire the Series 2019 Bonds that are Term Bonds, if any, to be called by mandatory redemption or to be paid at maturity on such June 1 in accordance with the Sinking Fund Requirement therefor.

In addition, the Trustee shall deposit to the credit of the Series 2019 Subaccount of the Redemption Account all amounts as shall be delivered to the Trustee by OWASA from time to time with instructions that such amounts be so deposited for the redemption of the Series 2019 Bonds.

Section 13. Investment of Money. Money held for the credit of the Series 2019 Additional Project Account and the subaccounts established by this Series Resolution shall be continuously invested and reinvested by the Trustee at the written direction of an Authorized Officer in Investment Obligations to the extent practicable. Any such Investment Obligations shall mature not later than the respective dates when the money held for the credit of such accounts or subaccounts will be required for the purposes intended. No Investment Obligations in any such account or subaccount may mature beyond the latest maturity date of any Series 2019 Bonds Outstanding at the time such Investment Obligations are deposited.

Investment Obligations acquired with money in or credited to any account or subaccount established hereunder shall be deemed at all times to be part of such account or subaccount. Any loss realized upon the disposition or maturity of such Investment Obligations shall be charged against such account or subaccount. The interest accruing on any such Investment Obligations and any profit realized upon the disposition or maturity of such Investment Obligations shall be credited to such account or subaccounts as follows:

Accounts or Subaccounts	Credited to
Series 2019 Additional Project Account	Series 2019 Additional Project Account
All Subaccounts	Respective Subaccounts

Any such interest accruing and any such profit realized shall be transferred upon the receipt thereof by OWASA or the Trustee, as the case may be, pursuant to the provisions of the Order and this Series Resolution.

An Authorized Officer shall give to the Trustee written directions respecting the investment of any money required to be invested hereunder, subject, however, to the provisions of this Section, and the Trustee shall then invest such money as so directed. The Trustee may request in writing additional direction or authorization from the Authorized Officer with respect to the proposed investment of money. Upon receipt of such directions, the Trustee shall invest, subject to the provisions of this Section, such money in accordance with such directions. The Trustee shall not be liable to OWASA for any loss suffered by OWASA as a result of or in connection with any investment in Investment Obligations made by the Trustee in good faith as instructed by or approved by an Authorized Officer.

The Trustee shall sell at the best price obtainable or, acting in a commercially reasonable manner, reduce to cash a sufficient amount of such Investment Obligations whenever it is necessary to do so in order to provide money to make any payment from any such account or subaccount. The Trustee shall not be liable or responsible for any loss resulting from any such investment.

Whenever a transfer of money between two or more of the accounts or subaccounts is permitted or required, such transfer may be made as a whole or value determined at the time of such transfer in accordance with Article VI of the Order, provided that the Investment Obligations transferred are those in which money of the receiving account or subaccount could be invested at the date of such transfer.

The Trustee may conclusively rely upon the Authorized Officer's written instructions as to both the suitability and legality of all directed investments. The Trustee may make any and all such investments through its own investment department or that of its affiliates or subsidiaries, and may charge its ordinary and customary fees for such investments. In the absence of written investment instructions from the Authorized Officer, the Trustee shall not be responsible or liable for keeping the moneys held by it hereunder fully invested.

Although OWASA recognizes that it may obtain a broker confirmation or written statement containing comparable information at no additional cost, OWASA hereby agrees that broker confirmations of permitted investments are not required to be issued by the Trustee for each month in which a monthly statement is rendered by the Trustee.

Section 14. Approval of Official Statement. The Preliminary Official Statement, to be dated on or about November 6, 2019, relating to the Series 2019 Bonds (the "Preliminary Official Statement") is hereby approved. OWASA hereby authorizes the use and distribution of the Preliminary Official Statement by Wells Fargo Bank, National Association (the "Underwriter"). OWASA authorizes and consents to the preparation and distribution of a final Official Statement relating to the Series 2019 Bonds (the "Official Statement"), in substantially the form of the Preliminary Official Statement, together with such changes as are necessary to reflect the final terms of the Series 2019 Bonds. The Chair, the Vice-Chair or the Executive Director of OWASA is hereby authorized and directed to execute and deliver the Official Statement, in substantially the form of the Preliminary Official Statement, together with such changes, modifications, insertions and deletions as the Chair, the Vice-Chair or the Executive Director of OWASA, with the advice of counsel, may deem necessary and appropriate; such execution and delivery shall be conclusive evidence of the approval and authorization in all respects of the form and content thereof.

Section 15. LGC Requested to Award the Series 2019 Bonds. OWASA hereby requests that the Local Government Commission of North Carolina award the Series 2019 Bonds in a negotiated sale without advertisement to the Underwriter, in the amount and at the interest rates fixed pursuant to this Series Resolution, at a purchase price of not less than ninety-nine percent (99.00%) of the par amount of the Series 2019 Bonds, less the amount of any original issue discount, plus the amount of any original issue premium on the Series 2019 Bonds, subject to the approval thereof by the Chair, the Vice-Chair or the Executive Director of OWASA.

Section 16. Approval of Bond Purchase Agreement. OWASA hereby approves the Bond Purchase Agreement relating to the Series 2019 Bonds (the "Bond Purchase Agreement"), in substantially the form of the draft presented at this meeting, and hereby authorizes the Chair, the Vice-Chair or the Executive Director of OWASA to execute the Bond Purchase Agreement, in substantially the form of said draft, together with such changes, modifications, insertions and deletions, as he or she, with the advice of counsel, may deem necessary and appropriate; such execution and delivery shall be conclusive evidence of the approval and authorization thereof by OWASA.

Section 17. Continuing Disclosure. OWASA hereby undertakes, for the benefit of the beneficial owners of the Series 2019 Bonds, to provide:

(A) by not later than seven months from the end of each Fiscal Year, commencing with the Fiscal Year ending June 30, 2020, to the MSRB, audited financial statements of OWASA for such Fiscal Year, if available, prepared in accordance with Section 159-34 of the General Statutes of North Carolina, as it may be amended from time to time, or any successor statute, or, if such audited financial statements of OWASA are not available by seven months from the end of such Fiscal Year, unaudited financial statements of OWASA for such Fiscal Year to be replaced subsequently by audited financial statements of OWASA to be delivered within 15 days after such audited financial statements become available for distribution;

(B) by not later than seven months from the end of each Fiscal Year, commencing with the Fiscal Year ending June 30, 2020, to the MSRB, (i) the financial and statistical data as of a date not earlier than the end of the preceding Fiscal Year for the type of information included under the following headings and tables in Appendix A to the Official Statement relating to the Series 2019 Bonds to the extent such items are not included in the financial statements referred to in (A) above:

(1) "Rates, Fees and Charges" (tables and other rate information therein, excluding tables showing comparative bills for surrounding municipalities and future rate increases);

(2) "Customer Accounts" (tables therein); and

(3) "Historical Operating Results" (table therein);

(C) in a timely manner, not in excess of ten business days after the occurrence of the event, to the MSRB, notice of any of the following events with respect to the Series 2019 Bonds:

(1) principal and interest payment delinquencies;

(2) non-payment related defaults, if material;

(3) unscheduled draws on any debt service reserves reflecting financial difficulties;

(4) unscheduled draws on any credit enhancements reflecting financial difficulties;

(5) substitution of any credit or liquidity providers, or their failure to perform;

(6) adverse tax opinions, the issuance by the Internal Revenue Service of proposed or final determinations of taxability, Notices of Proposed Issue (IRS Form 5701-TEB) or other material notices or determinations with respect to the tax status of the Series 2019 Bonds, or other material events affecting the tax status of the Series 2019 Bonds;

(7) modification to the rights of the beneficial owners of the Series 2019 Bonds, if material;

(8) bond calls, other than bond calls relating to any mandatory sinking fund redemptions, if material, and tender offers;

(9) defeasances;

(10) release, substitution or sale of any property securing repayment of the Series 2019 Bonds, if material;

(11) rating changes;

(12) bankruptcy, insolvency, receivership or similar event of OWASA, which shall be considered to occur when any of the following occur: the appointment of a receiver, fiscal agent or similar officer for OWASA in a proceeding under Title 11 of the United States Code or in any other proceeding under state or federal law in which a court or governmental authority has assumed jurisdiction over substantially all of the assets or business of OWASA, or if such jurisdiction has been assumed by leaving the existing governing body and officials or officers in possession but subject to the supervision and orders of a court or governmental authority, or the entry of an order confirming a plan of reorganization, arrangement or liquidation by a court or governmental authority having supervision or jurisdiction over substantially all of the assets or business of OWASA;

(13) the consummation of a merger, consolidation, or acquisition involving OWASA or the sale of all or substantially all of the assets of OWASA, other than in the ordinary course of business, the entry into a definitive agreement to undertake such an action or the termination of a definitive agreement relating to any such actions, other than pursuant to its terms, if material;

(14) appointment of a successor or additional Trustee or the change of name of a Trustee, if material;

(15) incurrence of a financial obligation (as defined below) of OWASA, if material, or agreement to covenants, events of default, remedies, priority rights, or other similar terms of a financial obligation of OWASA, any of which affect beneficial owners of the Series 2019 Bonds, if material; and

(16) default, event of acceleration, termination event, modification of terms, or other similar events under the terms of a financial obligation of OWASA, any of which reflect financial difficulties; and

(D) in a timely manner, to the MSRB, notice of a failure of OWASA to provide required annual financial information described in (A) or (B) above on or before the date specified.

For purposes of this Section, "financial obligation" means (a) a debt obligation, (b) a derivative instrument entered into in connection with, or pledged as security or a source of payment for, an existing or planned debt obligation, or (c) a guarantee of either clause (a) or (b) above. The term "financial obligation" shall not include municipal securities as to which a final official statement has been provided to the MSRB consistent with Rule 15c2-12 issued under the Securities Exchange Act of 1934, as amended ("Rule 15c2-12").

OWASA shall provide the documents referred to above to the MSRB in an electronic format as prescribed by the MSRB and accompanied by identifying information as prescribed by the MSRB.

OWASA may discharge its undertaking described above by transmitting the documents referred to above to any entity and any method authorized by the U.S. Securities Exchange Commission.

If OWASA fails to comply with the undertaking described above, the Trustee or any beneficial owner of the Series 2019 Bonds then Outstanding may, but the Trustee shall not be required to, take action to protect and enforce the rights of beneficial owners with respect to such undertaking, including an action for specific performance; provided, however, that OWASA's failure to comply with the undertaking will not constitute an event of default under the Bond Order and will not result in any acceleration of payment of the Series 2019 Bonds. All actions shall be instituted, had and maintained in the manner provided in this paragraph for the benefit of the beneficial owners of the Series 2019 Bonds.

OWASA reserves the right to modify from time to time the information to be provided to the extent necessary or appropriate in the judgment of OWASA, provided that:

(a) any such modification may only be made in connection with a change in circumstances that arises from a change in legal requirements, change in law, or change in the identity, nature, or status of OWASA; and

(b) the information to be provided, as modified, would have complied with the requirements of Rule 15c2-12 as of the date of the Official Statement, after taking into account any amendments or interpretations of Rule 15c2-12, as well as any changes in circumstances; and

(c) any such modification does not materially impair the interests of the beneficial owners, as determined either by parties unaffiliated with OWASA (such as bond counsel or the Trustee), or by approving vote of the registered owners of not less than fifty-one percent (51%)

in aggregate principal amount of the Series 2019 Bonds then Outstanding pursuant to the terms of the Order, as it may be amended from time to time.

OWASA also agrees that the annual financial information containing the amended operating data or financial information will explain, in narrative form, the reasons for the amendments and the impact of the change in the type of operating data or financial information being provided.

The provisions of this Section shall terminate upon payment, or provision having been made for payment in a manner consistent with Rule 15c2-12, in full of the principal of and interest on all of the Series 2019 Bonds.

Section 18. Authorization to OWASA Officials. The officers, agents and employees of OWASA and the officers and agents of the Trustee and the Bond Registrar are hereby authorized and directed to do all acts and things required of them by the provisions of the Series 2019 Bonds, the Order, the Bond Purchase Agreement, this Series Resolution and any other related documents or agreements for the full, punctual and complete performance of the terms, covenants, provisions and agreements therein.

Section 19. Exclusion From Gross Income Covenant. OWASA covenants that it will not take any action which will, or fail to take any action which failure will, cause interest on the Series 2019 Bonds to become includable in the gross income of the owners thereof for federal income tax purposes pursuant to the provisions of the Internal Revenue Code of 1986, as amended.

Section 20. Electronic Communications. The Trustee shall have the right to accept and act upon directions given pursuant to this Series Resolution and delivered using Electronic Means. If OWASA elects to give the Trustee directions using Electronic Means and the Trustee in its discretion elects to act upon such directions, the Trustee's understanding of such directions shall be deemed controlling. OWASA understands and agrees that the Trustee cannot determine the identity of the actual sender of such directions and that the Trustee shall conclusively presume that directions that purport to have been sent by an Authorized Officer have actually been sent by such Authorized Officer. OWASA shall be responsible for ensuring that only Authorized Officers transmit such directions to the Trustee and that all Authorized Officers treat applicable user and authorization codes, passwords and/or authentication keys as confidential and with appropriate care. The Trustee shall not be liable for any losses, costs or expenses arising directly or indirectly from the Trustee's reliance upon and compliance with such directions notwithstanding such directions conflict or are inconsistent with a subsequent written direction. OWASA agrees: (i) to assume all risks arising out of the use of Electronic Means to submit directions to the Trustee, including without limitation the risk of the Trustee acting on unauthorized directions and the risk of interception and misuse by third parties; (ii) that it is fully informed of the protections and risks associated with the various methods of transmitting directions to the Trustee and that there may be more secure methods of transmitting directions; (iii) that the security procedures (if any) to be followed in connection with its transmission of directions provide to it a commercially reasonable degree of protection in light of its particular needs and circumstances; and (iv) to notify the Trustee immediately upon learning of any compromised or unauthorized use of the security procedures.

Section 21. Effective Date. This Series Resolution shall take effect immediately upon its adoption. Notwithstanding the foregoing, if the Chair, the Vice-Chair, the Executive Director or the Director of Finance and Customer Service of OWASA shall determine that no Series 2019 Bonds shall be Term Bonds, as specified in the Series Certificate required by Section 4 of this Series Resolution, the terms and provisions of this Series Resolution with respect to Term Bonds and the mandatory redemption of Term Bonds pursuant to the Sinking Fund Requirements therefor shall be of no further force and effect.

Adopted this 24th day of October, 2019.

_____
Raymond E. DuBose
Chair

ATTEST:

_____
Bruce Boehm
Secretary

APPENDIX A

DESCRIPTION OF THE 2019 PROJECT

1. Replacement of water mains (Fordham Service Road, Manning Drive (East), Country Club Road, Barclay Road, Scarlett-Cooper Neighborhood, Foxcroft Drive, Kensington Drive, and Jones Ferry Road);

2. Replacement and rehabilitation of water and wastewater pumping stations (University Lake and Rogerson Drive-Phase 2);

3. Chemical facility improvements and upgrades at the Jones Ferry Road Water Treatment Plant;

4. Replacement of sewer interceptor (Bolinwood Drive); and

5. Improvements to and rehabilitation of facilities and equipment at the Mason Farm Wastewater Treatment Plant.

SERIES RESOLUTION OF THE ORANGE WATER AND SEWER AUTHORITY RELATING TO THE ISSUANCE OF NOT EXCEEDING $11,000,000 WATER AND SEWER SYSTEM REVENUE REFUNDING BONDS, SERIES 2020 OF SAID AUTHORITY PURSUANT TO THE PROVISIONS OF SECTION 2.08 OF AN AMENDED AND RESTATED BOND ORDER ADOPTED BY SAID AUTHORITY ON SEPTEMBER 13, 2001, AS AMENDED, AND REQUESTING THE LOCAL GOVERNMENT COMMISSION OF NORTH CAROLINA TO AWARD SAID BONDS AT PRIVATE SALE

WHEREAS, the Orange Water and Sewer Authority ("OWASA"), a public body and body politic and corporate of the State of North Carolina, is authorized under the provisions of the North Carolina Water and Sewer Authorities Act, as amended, and The State and Local Government Revenue Bond Act, as amended (collectively, the "Act"), to acquire, lease, construct, reconstruct, improve, extend, enlarge, equip, repair, maintain and operate water and sewer systems or any part thereof within Orange County, North Carolina, to issue revenue bonds of OWASA to pay the cost of such water and sewer systems and to issue revenue refunding bonds; and

WHEREAS, OWASA has heretofore issued (a) $21,645,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2010, which are currently outstanding in the principal amount of $12,185,000 (the "Series 2010 Bonds"), (b) $15,695,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2014, which are currently outstanding in the principal amount of $13,375,000, and (c) $8,995,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2015, which are currently outstanding in the principal amount of $1,420,000, and (d) $18,075,000 principal amount of its Water and Sewer System Revenue Refunding Bonds, Series 2018, all of which are currently outstanding, pursuant to the Act and an amended and restated bond order adopted on September 13, 2001, as amended by a supplemental order adopted on October 28, 2010 (the Amended and Restated Bond Order, and any orders supplemental thereto and amendatory thereof, being hereinafter referred to as the "Order"); and

WHEREAS, Section 2.08 of the Order authorizes the issuance of revenue refunding bonds of OWASA in one or more series from time to time for refunding all or any part of the outstanding revenue bonds of any series issued under the Order or, to the extent permitted by law, other indebtedness; and

WHEREAS, OWASA has determined that it is desirable to refund all or a portion of the callable maturities of the outstanding Series 2010 Bonds and to pay the cost of such refunding by issuing an additional series of revenue refunding bonds and using any other available funds as authorized by Section 2.08 of the Order; and

WHEREAS, OWASA has determined that it will be able to satisfy the requirements of Section 2.08 of the Order with respect to the issuance of such series of revenue refunding bonds; and

WHEREAS, pursuant to Section 2.08 of the Order, such series of revenue refunding bonds is to have such terms and provisions as may be provided by a series resolution to be adopted by OWASA prior to the issuance thereof;

NOW, THEREFORE, THE ORANGE WATER AND SEWER AUTHORITY DOES HEREBY DETERMINE AND RESOLVE, as follows:

Section 1. Definitions. Unless otherwise required by the context, capitalized words and terms used in this Resolution (this "Series Resolution") and not otherwise defined herein shall have the same meanings in this Series Resolution as such words and terms are given in the Order, and the following words and terms shall have the following meanings:

"Bond Registrar" means The Bank of New York Mellon Trust Company, N.A. as designated by Section 2 of this Series Resolution, or any successor.

"Bond Year" means the period commencing on June 1 of any year and ending on May 31 of the following year.

"Business Day" means a day on which the Trustee, the Bond Registrar and the New York Stock Exchange are open for the purpose of conducting their businesses.

"Closing" means the delivery of and payment for the Series 2020 Bonds.

"Closing Date" means the date of the Closing.

"Costs of Issuance Account" means the account created and so designated by Section 5 of this Series Resolution.

"Electronic Means" means the following communication methods: e-mail; facsimile transmission; secure electronic transmission containing applicable authorization codes; passwords and/or authentication keys; or another method or system specified by the Trustee as available for use in connection with its services as Trustee under this Series Resolution.

"Interest Payment Date" means June 1, 2020, and each December 1 and June 1 thereafter, to and including the final maturity date of the Series 2020 Bonds.

"MSRB" means the Municipal Securities Rulemaking Board.

"Regular Record Date" means the 15th day of the month preceding any Interest Payment Date, whether or not a Business Day.

"Securities Depository" means The Depository Trust Company, New York, New York, or other recognized securities depository selected by OWASA, which maintains a book-entry system in respect of the Series 2020 Bonds, and shall include any substitute for or successor to the securities depository initially acting as Securities Depository.

"Securities Depository Nominee" means, as to any Securities Depository, such Securities Depository or the nominee of such Securities Depository in whose name there shall be registered on the registration books maintained by the Bond Registrar the Series 2020 Bond certificates to be delivered to such Securities Depository or its custodian during the continuation with such Securities Depository of participation in its book-entry system.

"Series Certificate" shall have the meaning given to such term by Section 4 of this Series Resolution.

"Series 2020 Bonds" means OWASA's Water and Sewer System Revenue Refunding Bonds, Series 2020.

"Series 2020 Subaccount of the Interest Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Series 2020 Subaccount of the Principal Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Series 2020 Subaccount of the Redemption Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Series 2020 Subaccount of the Sinking Fund Account" means the subaccount created and so designated by Section 5 of this Series Resolution.

"Sinking Fund Requirement" means, with respect to the Series 2020 Bonds that are Term Bonds, if any, for any Bond Year, the principal amount fixed or computed for retirement by purchase or redemption on or prior to June 1 of the following Bond Year.

The Sinking Fund Requirements shall be initially the respective principal amounts set forth in the Series Certificate.

The aggregate amount of such Sinking Fund Requirements for the Term Bonds, together with the amount due upon the final maturity of such Term Bonds, shall be equal to the aggregate principal amount of the Term Bonds. The Sinking Fund Requirements for the Term Bonds shall begin in the Bond Year determined as provided in the Series Certificate and shall end with the Bond Year immediately preceding the maturity of such Term Bonds (such final installment being payable at maturity and not redeemed). Any principal amount of Term Bonds retired by operation of the Series 2020 Subaccount of the Sinking Fund Account by purchase in excess of the total amount of the Sinking Fund Requirement for such Term Bonds, to and including such June 1, shall be credited against and reduce the future Sinking Fund Requirements for such Term Bonds in such manner as shall be specified in an Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution.

On or before the 45th day next preceding any June 1 on which Term Bonds are to be retired pursuant to the Sinking Fund Requirement, OWASA may deliver to the Trustee for cancellation Term Bonds required to be redeemed on such June 1 in any aggregate principal amount desired and receive a credit against amounts required to be transferred from the Series

2020 Subaccount of the Sinking Fund Account on account of such Term Bonds in the amount of 100% of the principal amount of any such Term Bonds so purchased. Any principal amount of Term Bonds purchased by the Trustee and cancelled in excess of the principal amount required to be redeemed on such June 1, shall be credited against and reduce the principal amount of future Sinking Fund Requirements in such manner as shall be specified in an Officer's Certificate in substantially the form of the Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution.

It shall be the duty of the Trustee, on or before the 15th day of July in each Bond Year, to recompute, if necessary, the Sinking Fund Requirement for such Bond Year and all subsequent Bond Years for the Term Bonds Outstanding based on the Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution. The Sinking Fund Requirement for such Bond Year as so recomputed shall continue to be applicable during the balance of such Bond Year and no adjustment shall be made therein by reason of Term Bonds purchased or redeemed or called for redemption during such Bond Year.

If any Term Bonds are paid or redeemed by operation of the Series 2020 Subaccount of the Redemption Account, the Trustee shall reduce future Sinking Fund Requirements therefor in such manner as shall be specified in an Officer's Certificate in substantially the form of the Officer's Certificate filed with the Trustee pursuant to Section 6 of this Series Resolution.

Section 2. Authorization of the Series 2020 Bonds Pursuant to the Order. (A) Series 2020 Bonds. Pursuant to the Act and Section 2.08 of the Order, OWASA hereby authorizes the issuance of revenue refunding bonds of OWASA, designated "Orange Water and Sewer Authority Water and Sewer System Revenue Refunding Bonds, Series 2020" (the "Series 2020 Bonds") in an aggregate principal amount not exceeding $11,000,000, for the purpose of providing funds, together with any other available funds, to (1) refund all or a portion of the callable maturities of the outstanding Series 2010 Bonds and (2) pay certain fees and expenses incurred in connection with the sale and issuance of the Series 2020 Bonds. Each Series 2020 Bond shall be dated the date of its delivery.

(B) Bond Provisions. The Series 2020 Bonds may consist of Serial Bonds and Term Bonds, shall bear interest at the rates, and shall mature, subject to any optional and mandatory sinking fund redemption, in the amounts and on the dates, all as hereinafter provided.

(C) Details; Interest Payment Dates. The Series 2020 Bonds shall be numbered consecutively from 2020-1 upward, shall be in the denomination of five thousand dollars ($5,000) and integral multiples thereof and shall be registered and exchangeable, and the transfer thereof may be registered, all in accordance with the provisions of the Order. Interest on the Series 2020 Bonds shall be payable semiannually on each June 1 and December 1, commencing on June 1, 2020, until the maturity thereof.

(D) Book-Entry. The Series 2020 Bonds shall be issued by means of a book-entry system with no physical distribution of bond certificates to be made except as hereinafter provided. One bond certificate with respect to each date on which the Series 2020 Bonds are stated to mature, in the aggregate principal amount of the Series 2020 Bonds stated to mature on such date and registered in the name of Cede & Co., as nominee of The Depository Trust

Company ("DTC"), will be issued and required to be deposited with DTC or its custodian. The book-entry system will evidence ownership of the Series 2020 Bonds in the principal amount of $5,000 or any multiple thereof, with transfers of ownership effected on the records of DTC and its participants pursuant to rules and procedures established by DTC and its participants. The principal of and any redemption premium on each Series 2020 Bond and interest with respect thereto shall be payable to Cede & Co., or any other person appearing on the registration books maintained by the Bond Registrar, as the registered owner of such Series 2020 Bond or its registered assigns or legal representatives. Transfer of principal, interest and any redemption premium payments to participants of DTC will be the responsibility of DTC, and transfer of principal, interest and any redemption premium payments to beneficial owners of the Series 2020 Bonds by participants of DTC will be the responsibility of such participants and other nominees of such beneficial owners. OWASA, the Bond Registrar and the Trustee shall not be responsible or liable for such transfers of payments or for maintaining, supervising or reviewing records maintained by DTC, its participants or persons acting through such participants.

In the event that (a) DTC determines not to continue to act as Securities Depository for the Series 2020 Bonds or (b) OWASA determines that continuation of the book-entry system of evidence and transfer of ownership of the Series 2020 Bonds would adversely affect the interests of the beneficial owners of the Series 2020 Bonds, OWASA shall discontinue the book-entry system with DTC. If OWASA identifies another qualified Securities Depository to replace DTC, OWASA shall make arrangements with DTC and such other Securities Depository to effect such replacement and deliver replacement Series 2020 Bonds registered in the name of such other Securities Depository or its Securities Depository Nominee in exchange for the outstanding Series 2020 Bonds, and the references to DTC or Cede & Co. in this Series Resolution shall thereupon be deemed to mean such other Securities Depository or its Securities Depository Nominee. If OWASA fails to identify another qualified Securities Depository to replace DTC, OWASA shall deliver replacement Series 2020 Bonds in the form of fully registered certificates in the denomination of $5,000 or any multiple thereof in exchange for the outstanding Series 2020 Bonds as required by DTC. The transferor shall, in connection with any transfer of Series 2020 Bonds outside the book-entry system, including, but not limited to, on or prior to the initial transfer of Series 2020 Bonds outside the book-entry system, provide or cause to be provided to the Trustee all information necessary to allow the Trustee to comply with any applicable tax reporting obligations, including without limitation any cost basis reporting obligations under Section 6045 of the Code. The Trustee may rely on the information provided to it and shall have no responsibility to verify or ensure the accuracy of such information.

(E) Bond Registrar. The Bank of New York Mellon Trust Company, N.A. is hereby appointed Bond Registrar for the Series 2020 Bonds.

Section 3. Delegation and Standards. OWASA hereby delegates to the Chair, the Vice-Chair, the Executive Director or the Director of Finance and Customer Service of OWASA, subject to the limitations contained herein, the power to determine and carry out the following with respect to the Series 2020 Bonds:

(A) Principal Amount. To determine the aggregate principal amount of the Series 2020 Bonds, such principal amount, not to exceed $11,000,000, to be sufficient for the purposes described in Section 2(A) of this Series Resolution;

(B) Interest Rates. To determine the interest rate or rates on the Series 2020 Bonds, no such rate to exceed five percent (5.00%) per annum;

(C) Maturities and Maturity Amounts. To determine the maturities and maturity amounts of the Series 2020 Bonds, no such maturity to extend beyond June 1, 2026;

(D) Serial and Term Bonds. To determine which Series 2020 Bonds are Serial Bonds, if any, and which Series 2020 Bonds are Term Bonds, if any, and the Sinking Fund Requirements for any such Term Bonds;

(E) Redemption Provisions. To determine the optional redemption provisions (if any) for the Series 2020 Bonds; provided, however, that the redemption price shall not exceed 103% of the face amount of the Series 2020 Bonds to be redeemed;

(F) Date of Sale. To determine the date of the sale of the Series 2020 Bonds;

(G) Negotiated Sale. To approve the sale of the Series 2020 Bonds in a negotiated sale in accordance with the provisions of Section 16 of this Series Resolution; provided, however, that the true interest cost for the Series 2020 Bonds shall not exceed four percent (4.00%) per annum and, provided further, that the price for the Series 2020 Bonds shall not be less than ninety-nine percent (99.00%) of the par amount of the Series 2020 Bonds, less the amount of original issue discount, if any, plus the amount of original issue premium on the Series 2020 Bonds, if any;

(H) Series 2010 Bonds to be Refunded. To determine the callable maturities and principal amounts of the Series 2010 Bonds to be refunded with a portion of the proceeds of the Series 2020 Bonds; provided, however, that the net present value savings resulting from such refunding shall be not less than three percent (3.00%) with respect to such Series 2010 Bonds or the portions thereof to be refunded; and

(I) Other Provisions. To determine any other provisions deemed advisable and not in conflict with the provisions of this Series Resolution or the Order.

Section 4. Series Certificate. The Chair, the Vice-Chair, the Executive Director or the Director of Finance and Customer Service of OWASA shall execute a certificate or certificates (collectively, the "Series Certificate") evidencing the determinations or other actions taken by him pursuant to the authority granted in this Series Resolution, and any such Series Certificate shall be conclusive evidence of the action taken.

Section 5. Establishment of Account and Subaccounts. The following accounts and subaccounts are hereby established:

(a) Series 2020 Subaccount of the Interest Account;

(b) Series 2020 Subaccount of the Principal Account;

(c) Series 2020 Subaccount of the Redemption Account;

(d) Series 2020 Subaccount of the Sinking Fund Account; and

(e) Orange Water and Sewer Authority Water and Sewer System Revenue Refunding Bonds, Series 2020 Costs of Issuance Account.

The account and subaccounts mentioned above shall be established with and held by the Trustee pursuant to the Order and this Series Resolution.

Section 6. Sinking Fund Redemption Provisions for the Series 2020 Bonds. The Series 2020 Bonds that are Term Bonds, if any, shall be subject to mandatory redemption in part on each June 1, as specified in the Series Certificate required by Section 4 of this Series Resolution.

Money held in the Series 2020 Subaccount of the Sinking Fund Account shall be applied during each Bond Year to the purchase or retirement of Term Bonds then Outstanding as follows:

(a) The Trustee shall, at the written request of OWASA, endeavor to purchase and cancel Term Bonds or portions thereof subject to redemption by operation of the Series 2020 Subaccount of the Sinking Fund Account or maturing on the next ensuing June 1 at the most advantageous price obtainable with reasonable diligence. The purchase price of each such Term Bond shall not exceed par plus accrued interest to the date of purchase. The Trustee shall pay the interest accrued on such Term Bonds to the date of settlement therefor from the Series 2020 Subaccount of the Interest Account or other funds provided by OWASA and the balance of the purchase price from the Series 2020 Subaccount of the Sinking Fund Account, but no such purchase shall be made by the Trustee from money in the Series 2020 Subaccount of the Sinking Fund Account within the period of forty-five (45) days immediately preceding any June 1 on which such Term Bonds are subject to redemption. The aggregate purchase price of Term Bonds, exclusive of accrued interest, during such Bond Year shall not exceed the amount deposited in the Series 2020 Subaccount of the Sinking Fund Account on account of the Sinking Fund Requirement for the Term Bonds for such Bond Year. If in any Bond Year the sum of the amount on deposit in the Series 2020 Subaccount of the Sinking Fund Account for the payment of any Term Bonds and the principal amount of the Term Bonds that were purchased during such Bond Year pursuant to the provisions of this paragraph (a) or delivered during such Bond Year to the Trustee by OWASA exceeds the Sinking Fund Requirement for the Outstanding Term Bonds for such Bond Year, the Trustee shall endeavor to purchase Outstanding Term Bonds with such excess money; and

(b) The Trustee shall call for redemption on June 1 immediately following the then current Bond Year the Term Bonds then subject to redemption in a principal amount equal to the aggregate Sinking Fund Requirement for the Term Bonds for such Bond Year, less the principal amount of any such Term Bonds retired during such Bond Year by purchase pursuant to paragraph (a) of this Section or delivered during such Bond Year to the Trustee by OWASA. If such June 1 is the stated maturity date of any such Term Bonds, the Trustee shall not call such Term Bonds for redemption but, on such maturity date, shall withdraw from the Sinking Fund Account and, not later than 10:00 A.M. on such date, remit by wire transfer to the Bond Registrar, in Federal Reserve or other immediately available funds, the amount required for paying the principal of such Term Bonds when due and payable. Not later than 10:00 A.M. on

each such redemption date, the Trustee shall withdraw from the Series 2020 Subaccount of the Sinking Fund Account and remit by wire transfer to the Bond Registrar, in Federal Reserve or other immediately available funds, the respective amounts required for paying the Redemption Price of the Term Bonds or portions thereof so called for redemption.

If, in any Bond Year, by the application of money in the Series 2020 Subaccount of the Sinking Fund Account, the Trustee should purchase or receive from OWASA and cancel Term Bonds in excess of the aggregate Sinking Fund Requirement for such Bond Year, the Trustee shall file with OWASA not later than the twentieth (20th) day prior to the next June 1 on which Term Bonds are to be redeemed, a statement identifying the Term Bonds purchased or delivered during such Bond Year and the amount of such excess. OWASA shall thereafter cause an Officer's Certificate to be filed with the Trustee not later than the tenth (10th) day prior to such June 1, setting forth with respect to the amount of such excess the Bond Years in which the Sinking Fund Requirements with respect to Term Bonds are to be reduced and the amount by which the Sinking Fund Requirements so determined are to be reduced.

Upon the retirement of any Term Bonds by purchase or redemption pursuant to the provisions of this Section, the Trustee shall file with OWASA a statement identifying such Term Bonds and setting forth the date of purchase or redemption, the amount of the purchase price or the Redemption Price of such Term Bonds, and the amount paid as interest thereon. The expenses incurred in connection with the purchase or redemption of any such Term Bonds shall be paid by OWASA as Current Expenses or from any other available moneys.

Section 7. Selection of Series 2020 Bonds for Redemption. The Series 2020 Bonds shall be redeemed only in whole multiples of five thousand dollars ($5,000). If less than all of the Series 2020 Bonds are to be called for redemption, the Series 2020 Bonds to be so redeemed shall be called for redemption in the manner that OWASA shall determine as set forth in an Officer's Certificate filed with the Trustee.

If less than all of the Series 2020 Bonds of any one maturity are called for redemption, the Bond Registrar shall select the Series 2020 Bonds to be redeemed by lot, each five thousand dollar ($5,000) portion of principal being counted as one Series 2020 Bond for this purpose; provided, however, that so long as the only registered owner of the Series 2020 Bonds is a Securities Depository Nominee, such selection shall be made by the Securities Depository.

Section 8. Redemption Notice. Not less than thirty (30) days but not more than sixty (60) days prior to the redemption date of any Series 2020 Bonds to be redeemed, whether such redemption be in whole or in part, the Bond Registrar shall cause a notice of any such redemption signed by the Bond Registrar to be mailed, first class, postage prepaid, to all Owners of Series 2020 Bonds to be redeemed in whole or in part, provided that notice to any Securities Depository shall be sent by Electronic Means if so required or requested by such Securities Depository and provided further that failure to give any such notice to any Owner or any defect in such notice shall not affect the validity of the proceedings for such redemption as to the Series 2020 Bonds of any other Owner to whom such notice has been properly given. Not less than thirty (30) days prior to the date of redemption, the Bond Registrar shall also give such notice of redemption to (A) the MSRB through its Electronic Municipal Market Access (EMMA) system and (B) the North Carolina Local Government Commission by first class mail, postage prepaid,

but failure to give such notice or any defect therein shall not affect the validity of any proceedings for the redemption of any Series 2020 Bonds. Notwithstanding anything to the contrary herein, OWASA acknowledges and agrees that the Bond Registrar is not acting as the disclosure/dissemination agent for purposes of Rule 15c2-12 (as defined herein) in connection with any notice required to be posted with the MSRB via its Electronic Municipal Marketplace Access (EMMA) system.

Each such notice shall set forth the designation and date of the Series 2020 Bonds, the CUSIP numbers of the Series 2020 Bonds to be redeemed, the date fixed for redemption, the Redemption Price to be paid, the address and phone number of the Trustee and Bond Registrar, the date of the redemption notice, the maturities of the Series 2020 Bonds to be redeemed and, if less than all of the Series 2020 Bonds of any one maturity then Outstanding shall be called for redemption, the distinctive numbers and letters, if any, of such Series 2020 Bonds to be redeemed and, in the case of Series 2020 Bonds to be redeemed in part only, the portion of the principal amount thereof to be redeemed. If any Series 2020 Bond is to be redeemed in part only, the notice of redemption shall also state also that on or after the redemption date, upon surrender of such Series 2020 Bond, a new Series 2020 Bond in principal amount equal to the unredeemed portion of such Series 2020 Bond will be issued.

Any notice of redemption (other than a notice given with respect to a mandatory sinking fund redemption) may state that the redemption to be effected is conditioned upon the receipt by the Trustee or Bond Registrar, on or prior to the redemption date, of moneys sufficient to pay the Redemption Price of and interest on the Series 2020 Bonds to be redeemed and that if such moneys are not so received such notice shall be of no force or effect and such Series 2020 Bonds shall not be required to be redeemed. In the event that such notice contains such a condition and moneys sufficient to pay the Redemption Price of and interest on such Series 2020 Bonds are not received by the Trustee or Bond Registrar on or prior to the redemption date, the redemption shall not be made and the Bond Registrar shall within a reasonable time thereafter give notice, in the manner in which the notice of redemption was given, that such moneys were not so received.

Section 9. Series 2020 Subaccount of the Redemption Account. The Trustee shall apply money in the Series 2020 Subaccount of the Redemption Account to the purchase or redemption of Series 2020 Bonds as follows:

(a) Subject to the provisions of paragraph (c) of this Section, upon the written request of OWASA, the Trustee shall endeavor to purchase and cancel Series 2020 Bonds or portions thereof, regardless of whether such Series 2020 Bonds or portions thereof are then subject to redemption, at the most advantageous price obtainable with reasonable diligence, provided that the purchase price of each Series 2020 Bond shall not exceed the Redemption Price that would be payable on the next redemption date to the Owner of such Series 2020 Bond under the provisions of the Series Certificate. The Trustee shall pay the interest accrued on such Series 2020 Bonds or portions thereof to the date of settlement from the Series 2020 Subaccount of the Interest Account or other funds provided by OWASA and the balance of the purchase price from the Series 2020 Subaccount of the Redemption Account, but no such purchase shall be made by the Trustee from money in the Series 2020 Subaccount of the Redemption Account within the period of forty-five (45) days immediately preceding any date on which such Series 2020 Bonds or portions thereof are to be redeemed.

(b) Subject to the provisions of paragraph (c) of this Section, the Trustee shall call for redemption on a date permitted by this Series Resolution and the Series Certificate such amount of Series 2020 Bonds or portions thereof as, with the redemption premium, if any, will exhaust the money then held in the Series 2020 Subaccount of the Redemption Account as nearly as may be practicable; provided, however, that not less than Fifty Thousand Dollars ($50,000) in principal amount of the Series 2020 Bonds shall be called for redemption at any one time unless the Trustee is so instructed in writing by OWASA. The Trustee shall pay the accrued interest on the Series 2020 Bonds or portions thereof to be redeemed to the date of redemption from the Series 2020 Subaccount of the Interest Account or other funds provided by OWASA and the Redemption Price of such Series 2020 Bonds or portions thereof from the Series 2020 Subaccount of the Redemption Account. The Trustee shall withdraw from the Series 2020 Subaccount of the Redemption Account and set aside the amount required to pay the Redemption Price of the Series 2020 Bonds or portions thereof so called for redemption.

(c) Money in the Series 2020 Subaccount of the Redemption Account shall be applied by the Trustee in each Fiscal Year to the purchase or the redemption of Series 2020 Bonds then Outstanding in accordance with the latest Officer's Certificate filed with the Trustee designating the Series 2020 Bonds to be redeemed. In the event no such certificate is filed (i) the Trustee shall apply such money to the purchase of Series 2020 Bonds bearing the highest rate of interest, (ii) if Series 2020 Bonds of more than one maturity bear the same interest rate, the Trustee shall redeem such Series 2020 Bonds in the inverse order of maturities, and (iii) if the Series 2020 Bonds bearing the highest rate of interest are Term Bonds, the Trustee shall reduce the Sinking Fund Requirements for such Term Bonds in inverse order of the scheduled redemption of such Term Bonds.

Upon the retirement of any Series 2020 Bonds by purchase or redemption pursuant to the provisions of this Section, the Trustee shall file with OWASA a statement identifying such Series 2020 Bonds and setting forth the date of purchase or redemption, the amount of the purchase price or the Redemption Price of such Bonds and the amount paid as interest thereon. The expenses incurred by the Trustee in connection with the purchase or redemption of any such Series 2020 Bonds shall be paid by OWASA from the Revenue Account as Current Expenses or from any other available moneys.

Section 10. Form of Series 2020 Bond. The Series 2020 Bonds and the Certificate of the North Carolina Local Government Commission and the Certificate of Authentication to be endorsed on all the Series 2020 Bonds shall be substantially in the following forms, with such variations, omissions and insertions as are required or permitted by the Order or this Series Resolution:

[Form of Series 2020 Bond]

No. R2020-__ $_____

United States of America
State of North Carolina

ORANGE WATER AND SEWER AUTHORITY

Water and Sewer System Revenue Refunding Bond,
Series 2020

Maturity Date	Dated Date	Interest Rate	CUSIP
June 1, 20__	_____ __, 2020	___%	_____

Principal Amount: _____ DOLLARS ($_____)

Registered Owner:

The Orange Water and Sewer Authority (the "Authority"), a public body and body politic and corporate of the State of North Carolina, is justly indebted and for value received hereby promises to pay, solely from the sources and in the manner hereinafter set forth, to the Registered Owner shown above or registered assigns or legal representative, on the maturity date specified above (or earlier as stated hereinafter), upon the presentation and surrender hereof at the corporate trust office of The Bank of New York Mellon Trust Company, N.A., in East Syracuse, New York, or any successor bond registrar (the "Bond Registrar"), the principal amount shown above, and to pay, solely from such sources, to the person in whose name this bond (or one or more Predecessor Bonds, as defined in the Order hereinafter mentioned) is registered at the close of business on the regular record date for such interest, which shall be the 15th day of the calendar month next preceding an interest payment date (the "Regular Record Date"), interest on this bond from the interest payment date next preceding the date on which it is authenticated, unless it is authenticated on an interest payment date, in which event it shall bear interest from such date, or it is authenticated prior to June 1, 2020, in which event it shall bear interest from its date, payable on June 1, 2020 and semiannually thereafter on December 1 and June 1 of each year, at the rate per annum specified above until the principal sum hereof is paid. Any such interest not so punctually paid shall forthwith cease to be payable to the person who was the registered owner on such Regular Record Date and may be paid to the person in whose name this bond (or one or more Predecessor Bonds) is registered at the close of business on a Special Record Date, as defined in the Order, for the payment of such defaulted interest to be fixed by the Trustee hereinafter mentioned, notice whereof being given to registered owners not more than fifteen (15) days and not less than ten (10) days prior to such Special Record Date, or may be paid in any other lawful manner not inconsistent with the requirements of applicable law or any securities exchange on which the bonds may be listed and upon such notice as may be required by such law or exchange, all as more fully provided in the Order. All such payments shall be made in the lawful money of the United States of America.

This bond is one of a duly authorized series of revenue refunding bonds of the Authority, designated "Orange Water and Sewer Authority Water and Sewer System Revenue Refunding Bonds, Series 2020" (the "Series 2020 Bonds"), and issued for the purpose of providing funds, together with any other available funds, to (i) refund a portion of the Authority's outstanding Water and Sewer System Revenue Refunding Bonds, Series 2010 (the "Series 2010 Bonds") and (ii) pay certain fees and expenses incurred in connection with the sale and issuance of the Series 2020 Bonds.

The Series 2020 Bonds are being issued by means of a book-entry system with no physical distribution of bond certificates to be made except as provided in the Series Resolution. One Series 2020 Bond certificate with respect to each date on which the Series 2020 Bonds are stated to mature, registered in the name of the Securities Depository Nominee (as defined in the Series Resolution), is being issued and required to be deposited with the Securities Depository (as defined in the Series Resolution) or its custodian. The book-entry system will evidence positions held in the Series 2020 Bonds by the Securities Depository's participants, beneficial ownership of the Series 2020 Bonds in the principal amount of $5,000 or any integral multiple thereof being evidenced in the records of such participants. Transfers of ownership will be effected on the records of the Securities Depository and its participants pursuant to rules and procedures established by the Securities Depository and its participants. The Authority, the Bond Registrar and the Trustee will recognize the Securities Depository Nominee, while the registered owner of this Series 2020 Bond, as the owner of this Series 2020 Bond for all purposes, including (i) payments of principal of, and redemption premium, if any, and interest on, this Series 2020 Bond, (ii) notices and (iii) voting. Transfer of principal, interest and any redemption premium payments to participants of the Securities Depository will be the responsibility of the Securities Depository, and transfer of principal, interest and any redemption premium payments to beneficial owners of the Series 2020 Bonds by participants of the Securities Depository will be the responsibility of such participants and other nominees of such beneficial owners. The Authority, the Bond Registrar and the Trustee will not be responsible or liable for such transfers of payments or for maintaining, supervising or reviewing the records maintained by the Securities Depository, the Securities Depository Nominee, the Securities Depository's participants or persons acting through such participants. While the Securities Depository Nominee is the registered owner of this Series 2020 Bond, notwithstanding the provisions hereinabove contained, payments of principal of, redemption premium, if any, and interest on this Series 2020 Bond shall be made in accordance with existing arrangements between the Bond Registrar or its successors under the Series Resolution and the Securities Depository.

The Series 2020 Bonds are being issued under and pursuant to the Constitution and laws of the State of North Carolina, including the North Carolina Water and Sewer Authorities Act, as amended, and The State and Local Government Revenue Bond Act, as amended (collectively, the "Act"), an amended and restated bond order duly adopted by the Authority on September 13, 2001, as amended by a supplemental order adopted by the Authority on October 28, 2010 (said amended and restated bond order, together with all orders supplemental and amendatory thereto as therein permitted, being herein called the "Order") and a series resolution duly adopted by the Authority on October 24, 2019 (the "Series Resolution"). The Authority has heretofore issued and secured under the Order, the Series 2010 Bonds, its Water and Sewer System Revenue Refunding Bonds, Series 2014 (the "Series 2014 Bonds"), its Water and Sewer System Revenue

Refunding Bonds, Series 2015 (the "Series 2015 Bonds"), its Water and Sewer System Revenue Refunding Bonds, Series 2018 (the "Series 2018 Bonds"), and its Water and Sewer System Revenue Bonds, Series 2019 (the "Series 2019 Bonds"). The Order provides for the issuance from time to time under the conditions, limitations and restrictions therein set forth of additional bonds to provide funds for paying all or any part of the cost of any Additional Project (as defined in the Order), to provide funds for completing payment of the cost of the Project (as defined in the Order) and any Additional Project, and to provide funds to pay the cost (including financing costs) of refunding any bonds issued under the Order, Parity Debt (as defined in the Order) or Subordinated Indebtedness (as defined in the Order) (such additional bonds, the Series 2020 Bonds, the Series 2019 Bonds, the Series 2018 Bonds, the Series 2015 Bonds, the Series 2014 Bonds and the unrefunded portion of the Series 2010 Bonds being herein collectively called the "Bonds"). Copies of the Order and the Series Resolution are on file at the corporate trust office of The Bank of New York Mellon Trust Company, N.A. (the "Trustee") in Jacksonville, Florida. By the acceptance of this bond, the registered owner hereof assents to all of the provisions of the Order and the Series Resolution.

The Series 2020 Bonds are special obligations of the Authority secured by a pledge, charge and lien upon Net Receipts (as defined in the Order). The Authority is not obligated to pay the principal of or the interest on the Series 2020 Bonds except, as provided in the Order, from Net Receipts or certain other monies made available therefor under the Order, and neither the faith and credit nor the taxing power of the State of North Carolina or any political subdivision thereof or the Authority is pledged to the payment of the principal of and the interest on the Series 2020 Bonds. The Order provides for the issuance or incurrence from time to time under the conditions, limitations and restrictions therein set forth of Bonds and Parity Debt (as defined in the Order) secured on a parity as to the pledge of Net Receipts.

Reference is made to the Order and the Series Resolution for a more complete statement of the provisions thereof and of the rights of the Authority, the Trustee and the registered owners of the Series 2020 Bonds.

The Order provides for the creation of a special fund designated "Orange Water and Sewer Authority Water and Sewer System Revenue Bonds Bond Fund" (the "Bond Fund"). Pursuant to the Series Resolution, special subaccounts have been created within the various accounts of the Bond Fund with respect to the Series 2020 Bonds (the "Subaccounts"), which Subaccounts are pledged to and charged with the payment of the principal of and the interest on the Series 2020 Bonds. The Series Resolution also provides for the deposit of Net Receipts to the credit of the Subaccounts to the extent and in the manner provided in the Order and the Series Resolution.

The Series 2020 Bonds are issuable as registered bonds without coupons, in denominations of $5,000 or any integral multiple thereof. At the designated corporate trust office of the Bond Registrar, in the manner and subject to the limitations and conditions provided in the Order, Series 2020 Bonds may be exchanged for an equal aggregate principal amount of Bonds of the same maturity, of authorized denominations and bearing interest at the same rate.

The transfer of this bond is registrable by the registered owner hereof in person or by his attorney or legal representative at the designated corporate trust office of the Bond Registrar but

only in the manner and subject to the limitations and conditions provided in the Order and upon surrender and cancellation of this bond. Upon any such registration of transfer the Authority shall execute and the Bond Registrar shall authenticate and deliver in exchange for this bond a new Series 2020 Bond or Series 2020 Bonds, registered in the name of the transferee, of authorized denominations, in aggregate principal amount equal to the principal amount of this bond, of the same maturity and bearing interest at the same rate. The Authority or the Bond Registrar may make a charge for every such exchange or registration of transfer of Series 2020 Bonds sufficient to reimburse it for any tax or other governmental charge required to be paid with respect to such exchange or registration of transfer, but no other charge shall be made to any registered owner for the privilege of exchanging or registering the transfer of Series 2020 Bonds. Neither the Authority nor the Bond Registrar shall be required to make any such exchange or registration of transfer of Series 2020 Bonds during the fifteen (15) days immediately preceding the date of first giving of notice of any redemption of Series 2020 Bonds or any portion thereof or of any Series 2020 Bond after such Series 2020 Bond or any portion thereof has been selected for redemption.

The Series 2020 Bonds maturing on or after June 1, 20__ are subject to redemption, at the option of the Authority, on or after June 1, 20__, in whole or in part (by lot within a maturity) at any time. Any such redemption will be at the redemption prices (expressed as a percentage of the principal amount of Series 2020 Bonds to be redeemed), plus accrued interest thereon to the redemption date, all as set forth in the following table:

Redemption Periods	Redemption Prices
June 1, 20__ through May 31, 20__	%
June 1, 20__ through May 31, 20__	
June 1, 20__ and thereafter	

The Series 2020 Bonds at the time outstanding that are stated to mature on June 1, 20__ are required to be redeemed in part by lot on June 1, 20__ and on each June 1 thereafter from moneys deposited with the Trustee for such purpose. Such redemption shall be at a redemption price equal to 100% of the principal amount of the Series 2020 Bonds to be redeemed, plus accrued interest thereon to the redemption date.

If less than all of the Series 2020 Bonds are to be called for redemption, the Series 2020 Bonds to be so redeemed shall be called for redemption in the manner that the Authority shall determine as set forth in an Officer's Certificate filed with the Trustee. If less than all of the Series 2020 Bonds of any one maturity are called for redemption, the Bond Registrar shall select the Series 2020 Bonds to be redeemed by lot, each $5,000 portion of principal being counted as one Series 2020 Bond for this purpose; provided, however, that so long as the only registered owner of the Series 2020 Bonds is the Securities Depository Nominee, such selection shall be made by the Securities Depository.

Not less than thirty (30) days but not more than sixty (60) days prior to the redemption date of any Series 2020 Bonds, either in whole or in part, the Bond Registrar shall cause a notice of any such redemption, signed by the Bond Registrar, to be mailed, first-class, postage prepaid, to all registered owners of Series 2020 Bonds or portions of Series 2020 Bonds to be redeemed at

their addresses as they appear on the registration books maintained by the Bond Registrar, but failure so to mail any such notice shall not affect the validity of the proceedings for such redemption as to any registered owners to whom such notice was given as so required. The Bond Registrar shall also cause a notice of any such redemption to be given to such other parties as provided in the Series Resolution. On the date designated for redemption, notice having been given as aforesaid, the Series 2020 Bonds or portions of Series 2020 Bonds so called for redemption shall become and be due and payable at the redemption price provided for the redemption of such Series 2020 Bonds or portions thereof on such date, and, if the moneys for payment of the redemption price and the accrued interest are held by the Bond Registrar, as provided in the Order, interest on such Series 2020 Bonds or portions thereof shall cease to accrue, such Series 2020 Bonds or portions thereof shall cease to be entitled to any benefit or security under the Order, and the registered owners thereof shall have no rights in respect of such Series 2020 Bonds or portions thereof except to receive payment of the redemption price thereof and the accrued interest so held by the Bond Registrar. If a portion of this bond shall be called for redemption, a new Series 2020 Bond or Series 2020 Bonds in principal amount equal to the unredeemed portion hereof will be issued to the registered owner upon surrender hereof.

With respect to any notice of redemption of Series 2020 Bonds (other than a notice given with respect to a mandatory sinking fund redemption), such notice may state that such redemption shall be conditional upon the receipt by the Trustee or the Bond Registrar, on or prior to the date fixed for such redemption, of moneys sufficient to pay the redemption price of and accrued interest on such Series 2020 Bonds to be redeemed, and that if such moneys shall not have been so received, said notice shall be of no force and effect and the Authority shall not be required to redeem such Series 2020 Bonds. In the event that such notice of redemption contains such a condition and such moneys are not so received, the redemption shall not be made and the Bond Registrar shall within a reasonable time thereafter give notice, in the manner in which the notice of redemption was given, that such moneys were not so received.

The registered owner of this bond shall have no rights to enforce the provisions of the Order or to institute action to enforce the covenants therein, or to take any action with respect to any event of default under the Order or to institute, appear in or defend any suit or other proceeding with respect thereto, except as provided in the Order.

In certain events, on the conditions, in the manner and with the effect set forth in the Order, the principal of all the Bonds and Parity Debt then outstanding under the Order may become or may be declared due and payable before the stated maturities thereof, together with the interest accrued thereon.

Modifications or alterations of the Order may be made by the Authority only to the extent and in the circumstances permitted by the Order.

As declared by the Act, this bond, subject only to the provisions for registration and registration of transfer stated herein and contained in the Order, is an investment security within the meaning of and for all the purposes of Article 8 of the Uniform Commercial Code of the State of North Carolina.

This bond is issued with the intent that the laws of the State of North Carolina shall govern its construction.

All acts, conditions and things required by the Constitution and laws of the State of North Carolina, the Order and the Series Resolution to happen, exist and be performed precedent to and in the issuance of this bond have happened, exist and have been performed as so required.

This bond shall not be valid or become obligatory for any purpose or be entitled to any benefit or security under the Order until this bond shall have been authenticated by the execution by the Bond Registrar of the certificate of authentication endorsed hereon.

IN WITNESS WHEREOF, the Orange Water and Sewer Authority has caused this bond to be signed by its Chair and its Secretary-Treasurer and the corporate seal of the Authority to be impressed hereon, all as of the ___ day of_____, 2020.

[Seal] ORANGE WATER AND SEWER AUTHORITY

By:_____
Chair

By:_____
Secretary-Treasurer

CERTIFICATE OF LOCAL GOVERNMENT COMMISSION

The issuance of the within bond has been approved under the provisions of The State and Local Government Revenue Bond Act of North Carolina.

_____
Secretary, Local Government Commission of North Carolina

CERTIFICATE OF AUTHENTICATION

This bond is one of the Bonds of the series designated therein and issued under the provisions of the within-mentioned Order and Series Resolution.

THE BANK OF NEW YORK MELLON TRUST COMPANY, N.A., as Bond Registrar

By:_____
Authorized Signatory

Date of authentication: _____

ASSIGNMENT

FOR VALUE RECEIVED the undersigned registered owner thereof hereby sells, assigns and transfers unto _____
_____
_____
[Please Print or Typewrite Name and Address of Transferee]

the within Bond and all rights thereunder and hereby irrevocably constitutes and appoints _____ attorney to register the transfer of said Bond on the books kept for registration thereof, with full power of substitution in the premises

Dated: _____

_____
NOTICE: The assignor's signature to this assignment must correspond with the name as it appears upon the face of the within Bond in every particular, without alteration or enlargement or any change whatever.

Signature Guaranteed:

_____
NOTICE: Signature must be guaranteed by an institution which is a participant in the Securities Transfer Agent Medallion program (STAMP) or similar program.

Section 11. Costs of Issuance Account. On the Closing Date, there shall be deposited to the Costs of Issuance Account the amount specified in clause (ii) of Section 12 of this Series Resolution. Money shall be disbursed from the Costs of Issuance Account, upon requisition of OWASA, for the purpose of paying the costs of issuance of the Series 2020 Bonds and, pending such disbursement, shall be held solely for the security of the Owners of the Series 2020 Bonds. Any balance remaining on deposit to the credit of the Costs of Issuance Account after the payment of the costs of issuance of the Series 2020 Bonds, as certified to the Trustee by an Authorized Officer of OWASA, shall be applied to such use or uses as shall be set forth in a written statement delivered to the Trustee by OWASA accompanied by an opinion of bond counsel to OWASA addressed to the Trustee to the effect that the proposed use or uses will not cause the interest on the Series 2020 Bonds to be includable in the gross income of the owners thereof for purposes of federal income taxation. In the event OWASA does not deliver an opinion of bond counsel as required by the preceding sentence, the Trustee shall transfer the money in excess of the amount then needed for Costs of Issuance to the Series 2020 Subaccount of the Principal Account and/or the Series 2020 Subaccount of the Sinking Fund Account, as determined by OWASA.

Section 12. Application of Proceeds of the Series 2020 Bonds. On the Closing Date, the Trustee shall apply the net proceeds of the Series 2020 Bonds as follows:

(i) the amount specified in the Series Certificate shall be deposited to the credit of the Series 2010 Subaccount of the Redemption Account created and so

designated by the Series Resolution for the Series 2010 Bonds and shall be applied to the redemption of the Series 2010 Bonds to be refunded on July 1, 2020; and

(ii) the balance of such proceeds shall be deposited to the credit of the Costs of Issuance Account.

Section 13. Application of Net Receipts. On or before the dates set forth below, OWASA shall, subject to the provisions of the Order, deposit or cause to be deposited, from Net Receipts held in the Revenue Account, with the Trustee the following amounts, and the Trustee shall apply such amounts to the various subaccounts and account specified in this Series Resolution in the following order:

(a) into the Series 2020 Subaccount of the Interest Account, on the Business Day immediately preceding each Interest Payment Date, an amount equal to the interest payable on the Series 2020 Bonds on such Interest Payment Date;

(b) into the Series 2020 Subaccount of the Principal Account, on the Business Day immediately preceding each June 1, beginning in the year specified in the Series Certificate, an amount equal to the principal of all Series 2020 Bonds that are Serial Bonds, if any, due on such June 1; and

(c) into the Series 2020 Subaccount of the Sinking Fund Account, on the Business Day immediately preceding each June 1, beginning in the year specified in the Series Certificate, the amount required to retire the Series 2020 Bonds that are Term Bonds, if any, to be called by mandatory redemption or to be paid at maturity on such June 1 in accordance with the Sinking Fund Requirement therefor.

In addition, the Trustee shall deposit to the credit of the Series 2020 Subaccount of the Redemption Account all amounts as shall be delivered to the Trustee by OWASA from time to time with instructions that such amounts be so deposited for the redemption of the Series 2020 Bonds.

Section 14. Investment of Money. Money held for the credit of the Costs of Issuance Account and the subaccounts established by this Series Resolution shall be continuously invested and reinvested by the Trustee at the written direction of an Authorized Officer in Investment Obligations to the extent practicable. Any such Investment Obligations shall mature not later than the respective dates when the money held for the credit of such accounts or subaccounts will be required for the purposes intended. No Investment Obligations in any such account or subaccount may mature beyond the latest maturity date of any Series 2020 Bonds Outstanding at the time such Investment Obligations are deposited.

Investment Obligations acquired with money in or credited to any account or subaccount established hereunder shall be deemed at all times to be part of such account or subaccount. Any loss realized upon the disposition or maturity of such Investment Obligations shall be charged against such account or subaccount. The interest accruing on any such Investment Obligations and any profit realized upon the disposition or maturity of such Investment Obligations shall be credited to such account or subaccounts as follows:

Accounts or Subaccounts	Credited to
Costs of Issuance Account	Costs of Issuance Account
All Subaccounts	Respective Subaccounts

Any such interest accruing and any such profit realized shall be transferred upon the receipt thereof by OWASA or the Trustee, as the case may be, pursuant to the provisions of the Order and this Series Resolution.

An Authorized Officer shall give to the Trustee written directions respecting the investment of any money required to be invested hereunder, subject, however, to the provisions of this Section, and the Trustee shall then invest such money as so directed. The Trustee may request in writing additional direction or authorization from the Authorized Officer with respect to the proposed investment of money. Upon receipt of such directions, the Trustee shall invest, subject to the provisions of this Section, such money in accordance with such directions. The Trustee shall not be liable to OWASA for any loss suffered by OWASA as a result of or in connection with any investment in Investment Obligations made by the Trustee in good faith as instructed by or approved by an Authorized Officer.

The Trustee shall sell at the best price obtainable or, acting in a commercially reasonable manner, reduce to cash a sufficient amount of such Investment Obligations whenever it is necessary to do so in order to provide money to make any payment from any such account or subaccount. The Trustee shall not be liable or responsible for any loss resulting from any such investment.

Whenever a transfer of money between two or more of the accounts or subaccounts is permitted or required, such transfer may be made as a whole or value determined at the time of such transfer in accordance with Article VI of the Order, provided that the Investment Obligations transferred are those in which money of the receiving account or subaccount could be invested at the date of such transfer.

The Trustee may conclusively rely upon the Authorized Officer's written instructions as to both the suitability and legality of all directed investments. The Trustee may make any and all such investments through its own investment department or that of its affiliates or subsidiaries, and may charge its ordinary and customary fees for such investments. In the absence of written investment instructions from the Authorized Officer, the Trustee shall not be responsible or liable for keeping the moneys held by it hereunder fully invested.

Although OWASA recognizes that it may obtain a broker confirmation or written statement containing comparable information at no additional cost, OWASA hereby agrees that broker confirmations of permitted investments are not required to be issued by the Trustee for each month in which a monthly statement is rendered by the Trustee.

Section 15. Approval of Official Statement. The Preliminary Official Statement, to be dated on or about November 6, 2019, relating to the Series 2020 Bonds (the "Preliminary Official Statement") is hereby approved. OWASA hereby authorizes the use and distribution of the Preliminary Official Statement by Wells Fargo Bank, National Association (the

"Underwriter"). OWASA authorizes and consents to the preparation and distribution of (i) a final Official Statement relating to the Series 2020 Bonds (the "Official Statement"), in substantially the form of the Preliminary Official Statement, together with such changes as are necessary to reflect the final terms of the Series 2020 Bonds, and (ii) a supplement to the Official Statement (the "Official Statement Supplement") containing updated information to the Official Statement. The Chair, the Vice-Chair or the Executive Director of OWASA is hereby authorized and directed to execute and deliver the Official Statement and the Official Statement Supplement, in each case with such changes, modifications, insertions and deletions as the Chair, the Vice-Chair or the Executive Director of OWASA, with the advice of counsel, may deem necessary and appropriate; such execution and delivery shall be conclusive evidence of the approval and authorization in all respects of the form and content thereof.

Section 16. LGC Requested to Award the Series 2020 Bonds. OWASA hereby requests that the Local Government Commission of North Carolina award the Series 2020 Bonds in a negotiated sale without advertisement to the Underwriter, in the amount and at the interest rates fixed pursuant to this Series Resolution, at a purchase price of not less than ninety-nine percent (99.00%) of the par amount of the Series 2020 Bonds, less the amount of any original issue discount, plus the amount of any original issue premium on the Series 2020 Bonds, subject to the approval thereof by the Chair, the Vice-Chair or the Executive Director of OWASA.

Section 17. Approval of Bond Purchase Agreement. OWASA hereby approves the Forward Delivery Bond Purchase Agreement relating to the Series 2020 Bonds (the "Bond Purchase Agreement"), in substantially the form of the draft presented at this meeting, and hereby authorizes the Chair, the Vice-Chair or the Executive Director of OWASA to execute the Bond Purchase Agreement, in substantially the form of said draft, together with such changes, modifications, insertions and deletions, as he or she, with the advice of counsel, may deem necessary and appropriate; such execution and delivery shall be conclusive evidence of the approval and authorization thereof by OWASA.

Section 18. Continuing Disclosure. OWASA hereby undertakes, for the benefit of the beneficial owners of the Series 2020 Bonds, to provide:

(A) by not later than seven months from the end of each Fiscal Year, commencing with the Fiscal Year ending June 30, 2020, to the MSRB, audited financial statements of OWASA for such Fiscal Year, if available, prepared in accordance with Section 159-34 of the General Statutes of North Carolina, as it may be amended from time to time, or any successor statute, or, if such audited financial statements of OWASA are not available by seven months from the end of such Fiscal Year, unaudited financial statements of OWASA for such Fiscal Year to be replaced subsequently by audited financial statements of OWASA to be delivered within 15 days after such audited financial statements become available for distribution;

(B) by not later than seven months from the end of each Fiscal Year, commencing with the Fiscal Year ending June 30, 2020, to the MSRB, (i) the financial and statistical data as of a date not earlier than the end of the preceding Fiscal Year for the type of information included under the following headings and tables in Appendix A to the Official Statement relating to the Series 2020 Bonds to the extent such items are not included in the financial statements referred to in (A) above:

(1) "Rates, Fees and Charges" (tables and other rate information therein, excluding tables showing comparative bills for surrounding municipalities and future rate increases);

(2) "Customer Accounts" (tables therein); and

(3) "Historical Operating Results" (table therein);

(C) in a timely manner, not in excess of ten business days after the occurrence of the event, to the MSRB, notice of any of the following events with respect to the Series 2020 Bonds:

(1) principal and interest payment delinquencies;

(2) non-payment related defaults, if material;

(3) unscheduled draws on any debt service reserves reflecting financial difficulties;

(4) unscheduled draws on any credit enhancements reflecting financial difficulties;

(5) substitution of any credit or liquidity providers, or their failure to perform;

(6) adverse tax opinions, the issuance by the Internal Revenue Service of proposed or final determinations of taxability, Notices of Proposed Issue (IRS Form 5701-TEB) or other material notices or determinations with respect to the tax status of the Series 2020 Bonds, or other material events affecting the tax status of the Series 2020 Bonds;

(7) modification to the rights of the beneficial owners of the Series 2020 Bonds, if material;

(8) bond calls, other than bond calls relating to any mandatory sinking fund redemptions, if material, and tender offers;

(9) defeasances;

(10) release, substitution or sale of any property securing repayment of the Series 2020 Bonds, if material;

(11) rating changes;

(12) bankruptcy, insolvency, receivership or similar event of OWASA, which shall be considered to occur when any of the following occur: the appointment of a receiver, fiscal agent or similar officer for OWASA in a proceeding under Title 11 of the United States Code or in any other proceeding under state or federal law in which a court or governmental authority has assumed jurisdiction over substantially all of the assets or

business of OWASA, or if such jurisdiction has been assumed by leaving the existing governing body and officials or officers in possession but subject to the supervision and orders of a court or governmental authority, or the entry of an order confirming a plan of reorganization, arrangement or liquidation by a court or governmental authority having supervision or jurisdiction over substantially all of the assets or business of OWASA;

(13) the consummation of a merger, consolidation, or acquisition involving OWASA or the sale of all or substantially all of the assets of OWASA, other than in the ordinary course of business, the entry into a definitive agreement to undertake such an action or the termination of a definitive agreement relating to any such actions, other than pursuant to its terms, if material;

(14) appointment of a successor or additional Trustee or the change of name of a Trustee, if material;

(15) incurrence of a financial obligation (as defined below) of OWASA, if material, or agreement to covenants, events of default, remedies, priority rights, or other similar terms of a financial obligation of OWASA, any of which affect beneficial owners of the Series 2020 Bonds, if material; and

(16) default, event of acceleration, termination event, modification of terms, or other similar events under the terms of a financial obligation of OWASA, any of which reflect financial difficulties; and

(D) in a timely manner, to the MSRB, notice of a failure of OWASA to provide required annual financial information described in (A) or (B) above on or before the date specified.

For purposes of this Section, "financial obligation" means (a) a debt obligation, (b) a derivative instrument entered into in connection with, or pledged as security or a source of payment for, an existing or planned debt obligation, or (c) a guarantee of either clause (a) or (b) above. The term "financial obligation" shall not include municipal securities as to which a final official statement has been provided to the MSRB consistent with Rule 15c2-12 issued under the Securities Exchange Act of 1934, as amended ("Rule 15c2-12").

OWASA shall provide the documents referred to above to the MSRB in an electronic format as prescribed by the MSRB and accompanied by identifying information as prescribed by the MSRB.

OWASA may discharge its undertaking described above by transmitting the documents referred to above to any entity and any method authorized by the U.S. Securities Exchange Commission.

If OWASA fails to comply with the undertaking described above, the Trustee or any beneficial owner of the Series 2020 Bonds then Outstanding may, but the Trustee shall not be required to, take action to protect and enforce the rights of beneficial owners with respect to such

undertaking, including an action for specific performance; provided, however, that OWASA's failure to comply with the undertaking will not constitute an event of default under the Bond Order and will not result in any acceleration of payment of the Series 2020 Bonds. All actions shall be instituted, had and maintained in the manner provided in this paragraph for the benefit of the beneficial owners of the Series 2020 Bonds.

OWASA reserves the right to modify from time to time the information to be provided to the extent necessary or appropriate in the judgment of OWASA, provided that:

(a) any such modification may only be made in connection with a change in circumstances that arises from a change in legal requirements, change in law, or change in the identity, nature, or status of OWASA; and

(b) the information to be provided, as modified, would have complied with the requirements of Rule 15c2-12 as of the date of the Official Statement, after taking into account any amendments or interpretations of Rule 15c2-12, as well as any changes in circumstances; and

(c) any such modification does not materially impair the interests of the beneficial owners, as determined either by parties unaffiliated with OWASA (such as bond counsel or the Trustee), or by approving vote of the registered owners of not less than fifty-one percent (51%) in aggregate principal amount of the Series 2020 Bonds then Outstanding pursuant to the terms of the Order, as it may be amended from time to time.

OWASA also agrees that the annual financial information containing the amended operating data or financial information will explain, in narrative form, the reasons for the amendments and the impact of the change in the type of operating data or financial information being provided.

The provisions of this Section shall terminate upon payment, or provision having been made for payment in a manner consistent with Rule 15c2-12, in full of the principal of and interest on all of the Series 2020 Bonds.

Section 19. Authorization to OWASA Officials. The officers, agents and employees of OWASA and the officers and agents of the Trustee and the Bond Registrar are hereby authorized and directed to do all acts and things required of them by the provisions of the Series 2020 Bonds, the Order, this Series Resolution, the Bond Purchase Agreement and any other related documents or agreements for the full, punctual and complete performance of the terms, covenants, provisions and agreements therein.

Section 20. Exclusion From Gross Income Covenant. OWASA covenants that it will not take any action which will, or fail to take any action which failure will, cause interest on the Series 2020 Bonds to become includable in the gross income of the owners thereof for federal income tax purposes pursuant to the provisions of the Internal Revenue Code of 1986, as amended.

Section 21. Electronic Communications. The Trustee shall have the right to accept and act upon directions given pursuant to this Series Resolution and delivered using Electronic

Means. If OWASA elects to give the Trustee directions using Electronic Means and the Trustee in its discretion elects to act upon such directions, the Trustee's understanding of such directions shall be deemed controlling. OWASA understands and agrees that the Trustee cannot determine the identity of the actual sender of such directions and that the Trustee shall conclusively presume that directions that purport to have been sent by an Authorized Officer have actually been sent by such Authorized Officer. OWASA shall be responsible for ensuring that only Authorized Officers transmit such directions to the Trustee and that all Authorized Officers treat applicable user and authorization codes, passwords and/or authentication keys as confidential and with appropriate care. The Trustee shall not be liable for any losses, costs or expenses arising directly or indirectly from the Trustee's reliance upon and compliance with such directions notwithstanding such directions conflict or are inconsistent with a subsequent written direction. OWASA agrees: (i) to assume all risks arising out of the use of Electronic Means to submit directions to the Trustee, including without limitation the risk of the Trustee acting on unauthorized directions and the risk of interception and misuse by third parties; (ii) that it is fully informed of the protections and risks associated with the various methods of transmitting directions to the Trustee and that there may be more secure methods of transmitting directions; (iii) that the security procedures (if any) to be followed in connection with its transmission of directions provide to it a commercially reasonable degree of protection in light of its particular needs and circumstances; and (iv) to notify the Trustee immediately upon learning of any compromised or unauthorized use of the security procedures.

Section 22. Effective Date. This Series Resolution shall take effect immediately upon its adoption. Notwithstanding the foregoing, if the Chair, the Vice-Chair, the Executive Director or the Director of Finance and Customer Service of OWASA shall determine that no Series 2020 Bonds shall be Term Bonds, as specified in the Series Certificate required by Section 4 of this Series Resolution, the terms and provisions of this Series Resolution with respect to Term Bonds and the mandatory redemption of Term Bonds pursuant to the Sinking Fund Requirements therefor shall be of no further force and effect.

Adopted this 24th day of October, 2019.

_____
Raymond E. DuBose
Chair

ATTEST:

_____
Bruce Boehm
Secretary

Agenda Item

- Care to Share Customer Assistance Day

Purpose

- Discuss the upcoming Care to Share Day and how the OWASA Board of Directors can support outreach efforts

Background

- The OWASA communications plan, approved by the OWASA Board at its February 28, 2019 meeting, proposed the creation of a Care to Share Day during which OWASA would mobilize staff, the Board of Directors, community members, customers and partners in a campaign to awareness of and funds for the Care to Share Customer Assistance Program.

- In alignment with the Thanksgiving Holiday, Care to Share Day is planned for Thursday November 21st, 2019.

- OWASA will share its plans for Care to Share Day, proposed for November 21, and the corresponding campaign in the lead-up to Thanksgiving. At the meeting, staff will share a revitalized Care to Share logo and an overview of the campaign.

Action

- Discuss plans for Care to Share Day

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

Memorandum

To: Board of Directors

Through: Ed Kerwin

From: Linda Low
Mary Tiger

Date: October 18, 2019

Subject: Care to Share Customer Assistance Day

Purpose

Provide background for a presentation on and the Board's discussion of the upcoming Care to Share Day and how the OWASA Board of Directors can support outreach efforts

Background

During the development of OWASA's annual communications plan (approved by the Board on February 28, 2019), the Care to Share was identified as an opportunity to for enhanced promotion to improve its impact in two ways: 1) support to families that cannot pay their water bill, and 2) engagement with the community-at-large. Care to Share is our voluntary customer assistance program that provides bill assistance to OWASA customers with difficulty paying their water and sewer bill.

Although recent efforts to encourage current contributors to switch to fixed-amount contributions rather than round-up contributions have resulted in a significant increase (contributions have increased 75%), the number of contributors has stagnated. Care to Share, which is administered by the Inter-Faith Council, currently does not receive enough funding annually to meet all requests that they receive from local families.

The OWASA communications plan proposed the creation of a Care to Share Day during which OWASA would mobilize staff, the Board of Directors, community members, customers and partners in a campaign to raise funds for the Care to Share Customer Assistance Program.

Care to Share Day

In alignment with the Thanksgiving Holiday, Care to Share Day is planned for Thursday November 21st. The call to action during the campaign can be summarized as follows: "Thanksgiving is upon us. Thankful for what we have, let's Care to Share and raise funds together to ensure local families unable to pay their water bills are not without this vital resource."

The campaign will engage OWASA staff, Board of Directors, community members, customers and partners to celebrate, raise awareness of, and increase participation in the Care to Share Customer Assistance Program.

Key "events" are planned to include:

- "Care to Share Pie" Day in the OWASA Community Room for OWASA Staff, OWASA Board of Directors, and our community partners to celebrate Care to Share (November 12, 2019)
- Official Recognition of Care to Share Day at the OWASA Board Meeting (November 14, 2019)
- Airing of the Pre-Taped Water Treatment Plant Tour on the "Tu for Two" Program – a feature that goes behind the scenes at unique sites, in this case, OWASA
- Social Media Campaign that shares stories, photos, and information to promote contributions to and participation in Care to Share (November 11 – November 21, 2019).
- Public Service Announcements on WCHL, featuring Youth Water Academy participants (November 11 – November 21, 2019).
- Wonderful Water radio live interview with IFC and OWASA (November 18, 2019)
- Lunch Hour Public Event at WCHL with the OWASA Water Wagon

Conclusion

We look forward to presenting the Board with an overview of the Care to Share Day campaign, as well as an updated logo (pasted below).

Proposed new logo



Existing logo



Linda Low
Communications and Community Relations Officer

Mary Tiger
Sustainability Manager

Agenda Item

- Water Main Break and Water Treatment Plant/Wastewater Treatment Plant Reliability and Risk Assessment Action Plans Progress Report

Purpose

- To update the OWASA Board of Directors on the ongoing efforts to improve the reliability of the services we provide to customers by reducing the risk of service interruptions.

Background

- Two system-wide water service disruptions in 2017 and 2018 resulted in the development of extensive action plans to improve the reliability of OWASA's service delivery.

- *November 5, 2018 Water Main Break Action Plan* - We have made or are in the process of making significant enhancements in the areas of valve inspection and maintenance, water treatment plant piping upgrades, and water main replacement prioritization model.

- *Water Treatment Plant and Wastewater Treatment Plant Reliability and Risk Assessment Action Plan* – We have programed all the capital improvements projects (CIP) in the Fiscal Year 2020-2024 CIP and are working through the operation and maintenance activities.

- Some of the action items included in these plans are long-lead-time initiatives that require extensive planning and significant resources to realize while others were implemented immediately.

- We will continue to work on completing the tasks identified in the action plans and provide a status report to the Board annually in October.

Action Needed

- Information item. No action is required.

October 24, 2019

TO: Board of Directors

THROUGH: Ed Kerwin

FROM: Todd Taylor, P.E.
Mary Darr, P.E.

DATE: October 17, 2019

SUBJECT: Water Main Break and Water Treatment Plant/Wastewater Treatment Plant Reliability and Risk Assessment Action Plans Progress Report

Purpose:

To update the OWASA Board of Directors on the ongoing efforts to improve the reliability of the services we provide to customers by reducing the risk of service interruptions.

Action Needed:

This update is provided for informational purposes and no action is required.

Background:

Two system-wide water service disruptions in 2017 and 2018 resulted in the development of extensive action plans (see attachments) to improve the reliability of OWASA's service delivery. The plans were developed by staff with the assistance of engineering consultants subsequent to the water service disruption events. These plans utilize capital investments in infrastructure as well as operational and emergency response improvements to mitigate potential risks in our water distribution system, water treatment plant (WTP) and wastewater treatment plant (WWTP). Some of the action items included in these plans are long-lead-time initiatives that require extensive planning and significant resources to realize while others were implemented immediately.

Update Summary:

The attachments provide a detailed status update of each item within the plans. Attachment 1 is the action plan for the November 5, 2018 water main break. Attachment 2 is the action plan for the WTP and WWTP Reliability and Risk Assessment conducted after the February 2017 water emergency. What follows is a brief summary highlighting some of the more significant initiatives that have been completed or are underway.

November 5, 2018 Water Main Break Action Plan:

This event demonstrated the importance of properly functioning isolation valves, the impact complex piping networks can have on emergency response, and the value of preplanning our response for breaks on critical water distribution system pipes. We have made or are in the process of making significant enhancements in each of these areas.

- Valve Inspection and Maintenance: Late last year, the Board approved additional resources (personnel and equipment) to establish a dedicated valve maintenance crew to improve our valve inspection and maintenance program to ensure isolation valves were both accessible and properly maintained to improve our response to water main breaks thereby minimizing the impacts to our customers. At the beginning of 2019, that crew was charged with locating, inspecting and exercising all of the large valves in our system (12-inch and larger) as well as all of the valves in the system for which no record of previous inspection existed (about 5,400 valves in total) by the end of calendar year 2019. The crew completed the initial scope of work well ahead of schedule and is now focused on addressing the broken or "missing" valves identified as part of the initial scope. They are also working to establish a four-year cycle for inspecting every valve in the system.

- WTP Piping Replacement Project: The complexity of the piping network in front of the Jones Ferry Road WTP is being addressed through a Capital Improvements Program (CIP) project led by our Engineering Department. This comprehensive plan will seek to greatly simplify the finished water piping scheme where it leaves the plant and abandon much of the old piping and appurtenances, while also providing improved redundancy. Our WTP and Distribution and Collection Departments have been engaged in the design process to ensure that designs meet their needs in terms of functionality, redundancy and operational simplicity. The design phase of this project is well underway and we look forward to having these improvements constructed.

- Water Main Replacement Prioritization Model: A part of the consultant's work on the Water Main Prioritization study will be to identify "critical" water mains in our system and develop main break emergency response plans (ERPs) for several of these. The ERPs will look for opportunities to reduce response times and define primary and secondary isolation activities. We are excited that the study has moved into this phase. The effort will be very inclusive and collaborative (i.e. involving many of our staff directly responsible for responding to water main breaks and involving staff from the University and Hospital). Our intent is to have the consultant assist us with the development of these initial ERPs, learn from that experience, and develop others in-house on an as-needed basis. In the future, we will also conduct training and drills based on the ERPs.

WTP and WWTP Reliability and Risk Assessment Action Plan:

The Reliability and Risk Assessment project completed in July 2018 identified and assessed risks that would prevent OWASA from providing water, wastewater, and reclaimed water services that meet or exceed federal, state, and local quality requirements. The action plan (Attachment

2), which was presented the Board's October 25, 2018 work session, is a combination of CIP projects, operation and maintenance activities, and other key findings from the assessment. The action plan has been updated to reflect current expected completion dates. Key accomplishments include:

- CIP Projects: All capital improvement projects identified by the assessment have been programed in the Fiscal Year (FY) 2020-2024 CIP. Several projects are under construction including WWTP headworks concrete rehabilitation (WW-R5) and Rogerson Drive pump station bypass improvements (WW-R1). The WTP finished water pump improvements (part of W-R3) and chemical feed system improvements (W-R6) are in design phase and will be bid this winter.

- Operation Activities: Standard operating procedures (SOPs) and documentation have been prepared and staff trained for WTP post-filter bypass (W-R2) and WTP chemical delivery (W-R11). WWTP staff have updated critical SOPs. They are reviewing, updating and training on the SOPs and process control procedures as they work to combine them into a single document (WWR-14).

- Maintenance Activities: Preventive maintenance has been completed on OWASA-owned electrical transformers at the WTP (W-R4). WTP and WWTP staff have reviewed vendor contracts and updated contact information in our Comprehensive Emergency Management Plan (CEMP) in the event we need their services during an emergency (WR-10). We have also converted the CEMP from hard copy to a SharePoint site so it is continuously updated. An unnecessary sluice gate (a type of valve) has been removed at the Morgan Creek pump station (WW-R4) to prevent accidental closure which could cause an overflow. Job Safety Analyses (W-R12 and WWR-15) are being conducted by Tyrus Johnson, our new Safety and Risk Manager, identifying hazards on critical tasks, eliminating or reducing risk if possible, establishing proper procedures, and ensuring that employees are trained.

In addition to the items listed in the action plans, we continue to focus on staff training and cross-training. For example, the WWTP staff of 22 has obtained 14 new certifications this year and 50% of those were from cross-disciplinary job functions. Two WWTP maintenance mechanics obtained treatment plant operator certifications and seven WWTP mechanics and operators obtained collection system operator certifications. Increasing knowledge of each other's roles and responsibilities leads to improved communication because we better understand how our work impacts others, which in turn, allows us to come together as a team to solve problems resulting in a more successful, fulfilling and creative work environment.

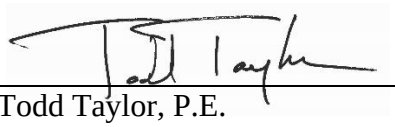
Next Steps:

We will continue to work on completing the tasks identified in the two action plans and provide a status report to the Board annually in October. We recommend replacing the risk and reliability assessment process with the recently legislated America's Water Infrastructure Act (AWIA) of 2018, which requires all water systems serving more than 3,300 people to develop or update risk assessments and emergency response plans. We recently issued a Request for Proposals and

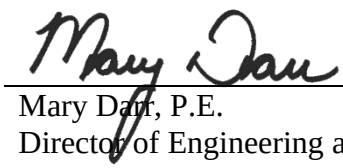
selected a consultant to help us with the AWIA assessments and emergency response plans. Although the AWIA legislation is only for water systems, we plan to use the same process to assess our wastewater system. OWASA's AWIA risk assessment certification must be submitted to the US EPA by December 31, 2020. AWIA requires OWASA to review its risk and resilience assessment at least once every five years to determine if it should be revised.

At the October 10, 2019 Work Session, the Board requested an update on lessons learned from the Rogerson Drive force main event. We suggest adding this to the annual update.

We appreciate the Board and community's continued support in improving the reliability and resiliency of the essential services we provide to the community. We look forward to providing this update on October 24, 2019 and will be happy to answer any questions you and members of the public may have.



Todd Taylor, P.E.
General Manager of Operations



Mary Darr, P.E.
Director of Engineering and Planning

Attachments:

Attachment 1 - November 5, 2018 Water Main Break Action Plan
Attachment 2 - WTP and WWTP Reliability and Risk Assessment Action Plan

November 5, 2018 Water Main Break Action Plan

No.	Action Item	Status	Notes
1	OC Alerts - Additional staffing needed	Complete	Additional staff has been trained and added to the on call list.
2	Critical spare parts inventory maintenance	Complete	Immediate needs have been addressed. However, ongoing maintenance is required.
3	Obtain approval from Durham to activate their valves at interconnections	Complete	No longer pursuing due to concerns about liabilities.
4	Repair valve box on 16” main	Complete	Repaired by contractor.
5	Investigate delay in Boil Water Advisory for Club Nova Apartments	Complete	This was an oversight and the issue has been addressed.
6	Reduce waste associated with expired bottled water inventory	Complete	We will donate bottled water to IFC one month before it is set to expire.
7	Accelerate our valve maintenance program, particularly on large transmission lines and critical areas. Determine what additional resources may be needed.	Complete	Additional staffing and equipment provided. The goal to inspect all critical and previously uninspected valves by the end of 2019 has be met.
8	Develop a interconnection inspection and testing protocol	Complete	A automated reminder has been placed in the CMMS to perform monthly inspections.
9	Research contracted resources for traffic control	Complete	A contract is not warranted due to lack of utilization on a routine basis.
10	Purchase updated couplings for 16” cast iron pipe	Complete	Couplings purchased.
11	Routinely train all D&C staff on mapping and how to safely and quickly isolate leaks from main breaks, especially in critical areas.	Ongoing	Routine training for employees will continue to be provided. In September, a tabletop exerciese was held with crew leaders and the prioitization model consultant to discuss the process.
12	Review the training and number of on-call staff for afterhours emergencies.	Complete	Limited resources due to persistent vacancies and staffing reductions due to Agua Vista.
13	Develop multiple "playbook" SOPs to focus EOC on different scenarios, such as major water main break versus WTP out of service, and consider establishing specialty cells to outline prioritization of limited resources and time sensitive activities, such as isolating the largest main first, or prioritizing isolation over establishing interconnects	Underway	To be addressed in the Water Main Prioritization Study. In September, a tabletop exerciese was held with crew leaders and the prioitization model consultant to discuss the process.

November 5, 2018 Water Main Break Action Plan

No.	Action Item	Status	Notes
14	Abandon 70-year old 16-inch cast iron piping	Underway	Will be abandoned as part of the Finished Water Piping Improvement Project.
15	Review key valves to ensure they are readily identifiable in the field and in GIS, and that GIS matches field condition	Ongoing	GIS data requires regular maintenance
16	Purchase and stage concrete barriers for water diversion to OWASA's emergency response package	Complete	12 concrete barriers and a specialized clamp to assist in moving them have been purchased.
17	Update Unplanned Water Main Repair SOP to address procedures for more complex multiple concurrent isolation activities and the role of interconnects	Underway	To be addressed in the Water Main Prioritization Study.
18	Update Finished Water Pumping SOP to include finished water pumping actions during unplanned water main breaks	Complete	SOP has been updated
19	Flow test on hydrant at intersection of E. Main St and Roberson St	Complete	Completed by crews
20	Review reporting procedures to ensure failed valves are captured in GIS for water main repair planning, and by the asset management program for repair prioritization	Complete	Improvements made in handheld data collector.
21	Evaluate emergency mapping capabilities	Complete	All employees have access to the WebGIS (24/7) map and can print. Staff training has been provided and can be scheduled as needed. Engineering Technicians can assist with mapping.
22	Update Interconnect SOPs for Hillsborough	Partially Complete	Updated the portion of the SOP related to receiving water from Hillsborough. Waiting on Hillsborough to complete improvements for sending water to them.
23	Valve mapping issues at intersection of E. Poplar and Oak Ave	Scheduled/ Underway	Durring valve mapping, faulty valves were dioscovered. Valves will be removed and replaced in the intersection of E. Poplar and Oak Ave. and a valve will be added in the intersection of Oak Ave. and Shelton St. Valve replacement work is scheduled for repair in the next 2 weeks.

November 5, 2018 Water Main Break Action Plan			
No.	**Action Item**	**Status**	**Notes**
24	Identify and install sampling sites throughout the service area.	Partially Complete	63% complete
25	Emergency Contact for American Stone	Complete	Contact identified.
26	Conduct tabletop exercises with a goal of achieving effective isolation at the secondary level, if necessary, within two hours	Underway	Will be addressed once Emergency Action Plans are developed in the Water Main Prioritization Study.
27	Evaluate response if similar event occurred outside of normal working hours.	Complete	SOPs have been added to the on-call toolkit and reviewed with the on-call personnel.
28	Provide each of the major water mains leaving the WTP with an above ground operator in a secure location on the WTP site	Underway	Will evaluate with the Finished Water Piping Improvement Project. Most on-site valves are in paved areas where maintenance vehicles travel.
29	Assess vulnerability of existing valves 8 inches and larger with buried operators in public locations for access and operation	Ongoing	The Valve Crew will identify opportunities as they inspect and exercise valves. Info can be entered into the crews' data loggers and then linked to GIS
30	Repair 20” valve in front of WTP	Underway	Issues with availability of replacement parts and accessing the valve for repair. Will be abandoned as a result of the Finished Water Piping Improvement Project.
31	Investigate issues with transferring water from the 740 pressure zone into the 640 pressure zone.	Complete	This particular instance was hydraulically unique due to the location of the break and the WTP finished water pumps being used in an attempt to maintain system pressures. This forced water towards the 740 pressure zone not allowing it to flow back into the 640 zone.
32	Consider additional pressure monitoring points and alarms to improve reliability and ensure adequate pressure throughout the system	Ongoing	Notification alarms have been added to the existing pressure readings. Additional sites and monitoring options are being explored.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Abbreviations

CIP	Capital Improvements Program	PM	Preventive Maintenance
FMEA	Failure Modes and Effects Analysis	SCADA	Supervisory Control and Data Acquisition
FY	Fiscal Year	SOP	Standard Operating Procedure
IT	Information Technology	UV	Ultraviolet
KF	Key Findings	VFD	Variable Frequency Drive
MCPS	Morgan Creek Pump Station	W	Water
O&M	Operation and Maintenance	WTP	Jones Ferry Road Water Treatment Plant
OT	Operations Technology	WW	Wastewater
PLC	Programmable Logic Controller	WWTP	Mason Farm Wastewater Treatment Plant

Jones Ferry Road Water Treatment Plant

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
W-R1	75	Clearwell	WTP Clearwell – Condition of the canvas curtain, which ensures adequate disinfectant contact time required by regulations, is unknown. Failure of drain line valve could drain the Clearwell. Failure of overflow standpipe could significantly reduce storage capacity of Clearwell.	Perform Clearwell inspection by diver to assess the condition of the following: joints between the clear well's concrete walls and floors, surface of concrete walls, expansion joints in the Clearwell floor, areas of sediment buildup, concrete roof support columns, stainless steel influent baffle plate, canvas curtain, mechanism supporting curtain, 12-inch overflow pipe, 12-inch drain line located under Clearwell and the associated valve, 30-inch effluent pipe to old Clearwell, and 60-inch influent pipe under generator (including valve and surrounding grout). Consider also including old Clearwell located in main building and two suction pipes associated with the old Clearwell. Address deficiencies identified by the condition assessments. Evaluate abandoning (filling) or replacing drain line and valve; relocating the overflow standpipe to outside of the Clearwell; and Clearwell redundancy.	FY 2020	The inspection of the Clearwell is planned for this winter (December or January).

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
W-R2	75	Post Filter Mix Tank and piping located between Filters and Clearwell	WTP Post-filter pipeline - This system is a single point of failure. Procedures for temporarily bypassing this system are not well known by staff nor formally documented.	Formally document bypass procedure used during prior construction project using archived as-builts. Also, prepare contact time calculations for bypass.	November 2018	Complete. A file at the Water Supply and Treatment SharePoint site contains these documents
W-R3	75	Electrical Distribution System	WTP electrical system - Configuration of the electrical power distribution system is complex due to the existence of both 2300 and 480 voltage systems.	Phased capital project to eliminate 2300 voltage system, which would involve converting finished water pump no.5 to 480 voltage.	FY 2021 FY 2022	A. The conversion of finished water pump no.5 to 480 voltage is being completed as part of CIP 272-42. Project design will be completed this winter, and construction from late Spring 2020 through late winter 2021. B. A project to convert the remaining 2300 voltage distribution system at WTP was initiated at the start of FY 2020. Designer selection process was recently completed and preliminary planning will begin this winter.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
W-R4	125	Electrical Distribution System	WTP electrical system - Various single-points of failure	Conduct component level PM identified in FMEA (gas in oil testing, thermographic survey, insulation test, turns ratio test, etc.)	June 2019	Testing of OWASA-owned transformers was completed.
W-R5	75	Finished Water Flow Meter	WTP finished water meter- Finished water flow meter is single point of failure. There is no finished water flow meter downstream of alternate chemical application vault, which is activated if primary chemical application vault fails.	Evaluate options for meter redundancy. Develop mitigation plan for failure of meter.	December 2018	Reviewed with our SCADA systems integrator. Temporary metering is an option to mitigate risk.
W-R6	75	Hypochlorite, Caustic, and Ammonia Chemical Feed Pumps	WTP chemical feed pumps - Chemical feed pumps were identified as a high risk due to condition and criticality. Difficult to maintain a wide variety of pumps (manufacturer, type, and capacity). Ancillary pumping equipment (check valves, pressure relief valve, etc.) and piping configuration may be inadequate.	CIP and O&M projects to replace hypochlorite, caustic, and ammonia chemical feed pumps. Undergo standardization process for chemical feed pumps.	FY 2021	Caustic, hypochlorite, and ammonia chemical feed system improvements are part of CIP 272-46. Project will be bid this winter, with construction expected from Spring 2020 through Spring 2021.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
W-R7	125	Various Locations	WTP VFD - Difficult to repair and replace VFDs due to equipment obsolescence and no bypass.	Upgrade VFDs as parts become obsolete. Evaluate VFD redundancy on critical equipment.	Ongoing Ongoing	 Critical system VFDs will be evaluated for redundancy/bypass as systems are assessed for replacement.
W-R8	75	SCADA	SCADA miscellaneous improvements and SOP Development - Inadequate feedback loops for pump on/off and remote/local signals, equipment obsolescence, inadequate historical backup, various single points of failure, and other miscellaneous issues.	Prepare SCADA Master Plan for both WTP and WWTP.	FY 2021	Water Facilities SCADA Master Plan is part of CIP 272-49. Wastewater Facilities SCADA Master Plan (WW-R11) was added to this scope. Project planning is underway, completion expected in FY 2021.
W-R9	75	SCADA	Firewall for SCADA system may be inadequate. Overlap and coordination between Information Technology (IT) and Operations Technology (OT).	Initiate Homeland Security Network Cybersecurity Audit	FY 2020	Coordinate Audit with WWTP WW-R12.
W-R10	75	Various Locations	Reliance on services conducted by key third-party vendors/contractors.	Prioritize and review key contracts (CITI, Electric Motor Shop, etc.) using information from Comprehensive Emergency Management Plan	October 2018	Complete
W-R11	75	Various Locations	Training and Standard Operating Procedures need to be improved.	Chemical unloading SOP for Bulk Delivery Drivers; flushing of chemicals annually, valve exercise to avoid overtightening, etc.	November 2018	Complete. The chemical delivery SOP was updated to include these action items.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
W-R12	75	Various Locations	Critical Spare & Job Safety Analysis	Perform Critical Spare Analysis (Identified in FMEA) Perform Job Safety Analysis (JSA) on critical tasks.	December 2020 Ongoing	Not started Underway. OWASA's new Safety and Risk Manager who started in March 2019 is conducting JSAs.

Mason Farm Wastewater Treatment Plant

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
WW-R1	75	Rogerson Drive Pump Station	WWTP Rogerson Drive pump station- Various single points of failure. Single electrical feed. Generator fuel storage is inadequate. Bypass is difficult.	Diesel fuel storage assessment. Upgrade pump station so that it can easily be bypassed if there is a catastrophic equipment failure. Install a generator access point, bare connection for a temporary electrical connection, and bypass connection point.	FY 2020	Diesel fuel assessment, including fuel management strategy and redundancy evaluation, will be completed in Spring 2020. Complete. Bypass improvements were completed as part of CIP 277-31.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
WW-R2	125	Morgan Creek Pump Station	WWTP MCPS Wet Well Stairs - Stair fasteners located in wet well may deteriorate rapidly due to corrosive environment and incompatible material.	Proactively replace wet well stair fasteners. Modify air intakes and dampers for better air turnover.	October 2018 FY 2020	Complete Modifications will be assessed and implemented as part of FY 2020 O&M budget.
WW-R3	75	Morgan Creek Pump Station	WWTP MCPS Influent Pump - No backup level control for Precision Digital level instrument	Install backup capacitance probe level sensor.	December 2019	Probe has been received.
WW-R4	75	Morgan Creek Pump Station	WWTP MCPS Influent Sluice Gates - Influent sluice gate could accidently close due to human error or equipment failure	Remove sluice gate.	Complete	Complete
WW-R5	75	Headworks	WWTP Headworks - Concrete located near the effluent of structure is in poor condition	Build bypass structure, rehabilitate concrete, and improve odor control system.	FY 2021	Construction is underway for WWTP Headworks concrete rehabilitation. Work is expected to be complete by Spring or Summer 2020.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
WW-R6	125	Electrical Distribution	WWTP Electrical System - Transformer A is single point of failure for electrical power to plant. Main Breaker A and B are single points of failure.	Conduct component level PM identified in FMEA (gas in oil testing, thermographic survey, insulation test, turns ratio test, etc.)	December 2019	Transformers are owned by Duke Energy. They do not conduct any component level testing. We will work with them to open these transformers to perform these tests.
			Components of backup power system are located in same building as main power.	Redesign of backup power system or installation of generator access point for critical systems.	Ongoing	Critical system generator access points will be evaluated as systems are assessed for upgrade/replacement. Addressing opportunistically.
WW-R7	125	Electrical Distribution	WWTP Electrical System - Penetration where electrical cables exit building and enter conduit tray.	Seal penetration in building and install screen below bus bar.	FY 2020	Work is expected to be complete Winter 2020.
WW-R8	75	Various Locations	WWTP VFD - Difficult to repair and replace VFDs due to equipment obsolesces and no bypass.	Upgrade VFDs as parts become obsolete	Ongoing	Up to date key spare VFDs in stock.
				Evaluate VFD redundancy on critical equipment.	Ongoing	Critical system VFDs will be evaluated for redundancy/bypass as systems are assessed for replacement.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
WW-R9	75	Chemical Tank Farm	WWTP Chemical Tank Farm - Incompatible chemicals could mix inside of the sodium hydroxide tank's secondary containment if there was a failure of both a sodium hydroxide tank/piping and acetic acid piping that passes through this containment area.	Address this issue as part of WWTP Chemical Building and Bulk Tank Piping Rehab.	FY 2021	Piping is being replaced as part of CIP 278-80, currently under design. Construction is expected to be complete by Fall 2020.
WW-R10	75	Ultraviolet (UV) Disinfection	WWTP UV Disinfection – The breaker serving the UV disinfection system is a single point of failure. This breaker has not been tested because the UV disinfection system is continuously operated. The programmable logic controller (PLC) that controls the UV disinfection system is a single point of failure and proprietary technology.	Coordinate temporarily stopping discharge of effluent, shutting off UV disinfection system, and testing breaker. Consider installing a generator access point. Sign a service contract with PLC manufacturer. Either develop a mitigation plan for failure of PLC or purchase a spare PLC.	June 2020 October 2018	No progress Complete

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
WW-R11	75	SCADA	SCADA miscellaneous improvements and SOP Development - Inadequate feedback loops for pump on/off and remote/local signals, equipment obsolescence, inadequate historical backup, various single points of failure, and other miscellaneous issues.	Prepare SCADA Master Plan for both WTP and WWTP.	FY 2021	Wastewater Facilities SCADA Master Plan will be completed in conjunction with Water Facilities SCADA Master Plan (CIP 272-49), planned for completion in FY 2021.
WW-R12	75	SCADA	SCADA - Firewall for SCADA system may be inadequate. Overlap and coordination between Information Technology (IT) and Operations Technology (OT).	Initiate Homeland Security Network Cybersecurity Audit	FY 2020	Coordinate Audit with WTP W-R9. WTP audit complete. Awaiting WWTP to be scheduled.
WW-R13	75	Various Locations	Reliance on services conducted by key third-party vendors/contractors	Prioritize and review key contracts (CITI, Electric Motor Shop, etc.) using information from Comprehensive Emergency Management Plan.	October 2018	Complete
WW-R14	75	Various Locations	Training and Standard Operating Procedures need to be improved	Combine SOP & Process Control Procedures into single document; prepare a chemical unloading SOP for bulk delivery drivers; biosolids driver procedure; etc.	June 2020	Combine SOP with Process Control Procedures still underway. Other SOPs have been addressed.

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Risk Priority Number	System	Risk Description	Treatment Plan	Target Completion Date	Notes/Status
WW-R15	75	Various Locations	Critical Spare & Job Safety Analysis	Perform Critical Spare Analysis (identified in FMEA) Perform Job Safety Analysis on critical tasks.	December 2019 Ongoing	Not started. Underway. OWASA's new Safety and Risk Manager who started in March 2019 is conducting JSAs.

Additional Key Findings

Risk No.	Group	Other Findings	Target Completion Date	Notes/Status
KF-1	Engineering	Perform cross-disciplinary reviews during the design phase of projects.	Ongoing	Cross-disciplinary reviews are utilized on most projects, beginning at project initiation.
KF-2	Engineering	While standardizing equipment provides value, continue to evaluate the entire system before applying a "one size fits all" approach—a pump that is appropriate in one operating context may not be appropriate in another.	Ongoing	
KF-3	Engineering	Consider the system of systems, as some processes impact others and should be reviewed holistically.	Ongoing	
KF-4	Engineering	Avoid relying solely on O&M to manage risk and instead consider how operators interact with the system and the ongoing maintenance in the design phase to minimize or ideally eliminate risk.	Ongoing	
KF-5	Operations & Maintenance	Communicate maintenance and operability concerns to the engineering staff so risk can be designed out of the systems.	Ongoing	
KF-6	Operations & Maintenance	Communicate between plants so that lessons learned at one can be applied to the other.	Ongoing	
KF-7	Operations & Maintenance	Maintain updated SOPs and Process Control Protocols.	Ongoing	

WTP and WWTP Reliability and Risk Assessment Action Plan - October 24, 2019

Risk No.	Group	Other Findings	Target Completion Date	Notes/Status
KF-8	Operations & Maintenance	Formalize relationships with third-party vendors and contractors to establish clearly defined roles and responsibilities.		See W-R10 and WW-R13
KF-9	Senior Leadership	Conduct risk analysis workshops of the remaining plant subsystems not included as part of this assessment. This will support detailed reviews of the current subsystems and designs.	TBD	Replace with AWIA risk assessment.
KF-10	Senior Leadership	Teach all staff members about risk and facilitate greater participation in risk analysis workshops.	Ongoing	
KF-11	Senior Leadership	Encourage cross-departmental communication because it takes an entire team to understand the OWASA subsystems in enough detail to evaluate risk.	Ongoing	
KF-12	Senior Leadership	Provide specialized training in electrical and SCADA systems.	Ongoing	
KF-13	Senior Leadership	Support knowledge transfer between employees and in succession planning.	Ongoing	
KF-14	Senior Leadership	Emphasize risk reduction across all departments.	Ongoing	
KF-15	Industry Best Practice	Review risk and reliability assessment evaluation every 5-years and/or whenever a change in operating context occurs.	FY 2024	

Agenda Item:

Administration of Strategic Plan:

A. Annual Review and Update of Strategic Trends and Utility Planning Issues
B. Strategic Plan Progress Report

Purpose:

To provide information about long-term trends and utility planning issues as well as provide an update on progress on the Strategic Plan's initiatives.

Background:

The Board of Directors adopted a Strategic Plan in March 2014 and updated it in June 2016.

The June 2016 update to the Strategic Plan stated that the *Annual Review and Update of Strategic Trends and Utility Planning Issues* report would be modified as a companion document to the Strategic Plan.

The *Annual Review and Update of Strategic Trends and Utility Planning Issues* summarizes recent OWASA utility trends and issues. This annual report summarizes observed trends in customer growth and demands, water supply and drinking water treatment, wastewater treatment, the reclaimed water system, environmental regulations, and technology to ensure that OWASA continues to provide high quality water, wastewater, and reclaimed water services. Staff will provide an overview of this report.

Strategic Plan:

Staff recommends the Board and staff begin the process to update the Strategic Plan in Fiscal Year 2021.

Action Needed:

No formal action needed; discussion and guidance to staff as desired by the Board of Directors. Does the Board of Directors agree to start planning the next Strategic Plan update in Fiscal Year 2021?

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

MEMORANDUM

TO: Board of Directors

THROUGH: Ed Kerwin

FROM: Ruth Rouse

DATE: October 18, 2019

SUBJECT: Annual Review and Update of Strategic Trends and Utility Planning Issues

Attached for your review and discussion is the 2018 edition of the "Annual Review and Update of Strategic Trends and Utility Planning Issues" (Attachment A). This annual report to the Board of Directors summarizes observed trends in the water, wastewater, and reclaimed water systems, environmental regulations, and technology to ensure that OWASA continues to provide high quality and reliable services. This report serves as a companion document to the June 9, 2016 Strategic Plan.

A few main points from the report are:

- Our customers have reduced peak day drinking water demands by 39 percent since FY 1999 despite a 31 percent increase in customer accounts over that same period. Similarly, demands on our raw water supply have decreased substantially. These reduced demands result from:
    - Increased water use efficiency and conservation by our customers
    - Conservation pricing and conservation ordinances including year-round water restrictions
    - Implementation of the reclaimed water system in partnership with the University of North Carolina at Chapel Hill in 2009, which now meets over 11 percent of the community's water needs.
- These reductions in drinking water demand – and the associated reductions in wastewater flows – help defer the need for costly expansion of the capacities of our raw water supplies, water and wastewater treatment plants. More efficient use of water also helps reduce costs for energy and chemicals for water and wastewater treatment.
- Based on current demands, we have sufficient raw water supply for the next few decades under most conditions. Our allocation of Jordan Lake water supply serves as an insurance policy to meet demands during extended droughts or operational emergencies.

- Based on current demands and projections, we anticipate no need to expand the hydraulic capacity of the water or wastewater treatment plants for several decades.
- We need to continue to invest in our renewal and replacement of infrastructure to ensure reliable and high quality service.

At the October 24, 2019 Board meeting, we will make a brief presentation highlighting some of the trends included in this report. We look forward to your questions and comments, as well as your feedback regarding the content of the report. We will incorporate any feedback into future annual trends reports for the Board.

Ruth C. Rouse

Ruth C. Rouse, AICP
Planning and Development Manager

Attachment A: Annual Review and Update of Strategic Trends and Utility Planning Issues
Attachment B: Strategic Plan Progress Report

Annual Review and Update of Strategic Trends and Utility Planning Issues for Fiscal Year 2019

OCTOBER 2019

Orange Water and Sewer Authority

Carrboro, North Carolina

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

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Purpose and Summary

This report summarizes observed trends for several indicators – such as customer growth and demands, water supply and drinking water treatment, wastewater treatment, use of reclaimed water, and environmental regulations – which are important factors that influence the need for, timing, and scope of our facilities planning and investment decisions. Through the process of regularly reviewing and updating this report, we strive to anticipate and proactively prepare for change so that we are better positioned to provide high quality and reliable water, wastewater, and reclaimed water services for the long-term. Some of the key messages are:

- Our customers have reduced peak day drinking water demands by 39 percent since Fiscal Year (FY) 1999 despite a 31 percent increase in customer accounts over that same period. Similarly, demands on our raw water supply have decreased substantially. These reduced demands result from:
    - Increased water use efficiency and conservation by our customers;
    - Conservation pricing and conservation ordinances including year-round water restrictions; and
    - Implementation of the reclaimed water system in partnership with the University of North Carolina at Chapel Hill (UNC) in 2009, which now meets over 11 percent of the community's water needs.
- These reductions in drinking water demand – and the associated reductions in wastewater flows – help defer the need for costly expansion of the capacities of our raw water supplies, water treatment plant, and wastewater treatment plant. More efficient use of water also helps reduce costs for energy and chemicals for water supply, drinking water treatment and water distribution, and wastewater collection and treatment.
- Based on current demands, we believe we have sufficient raw water supply for the next few decades under most conditions. Our allocation of Jordan Lake water supply, which we can access through our mutual aid agreements with the City of Durham and Town of Cary, serves as an insurance policy to meet demands during extended droughts or operational emergencies.
- Based on current demands and projections, we anticipate no need to expand the hydraulic capacity of the water or wastewater plant for several decades.
- OWASA is committed to providing high quality and reliable services to our customers. We have an asset management program to evaluate our infrastructure and risks and guide our investments in our ongoing maintenance and system renewal programs. The trends listed in this report are one mechanism to evaluate how well we meet our core mission.

Acronyms

AMI	advanced metering infrastructure
AMWA	Association of Metropolitan Water Agencies
AWIA	America's Water Infrastructure Act
AWWA	American Water Works Association
BG	billion gallons
CIP	Capital Improvements Program
CY	calendar year
DEQ	NC Department of Environmental Quality
EMC	NC Environmental Management Commission
EPA	US Environmental Protection Agency
ERP	Emergency Response Plan
FY	fiscal year (July – June)
GPR	ground penetrating radar
JLP	Jordan Lake Partnership
kWh	kilowatt-hour
KWh/MG	kilowatt-hour per million gallons
lb/yr	pounds per year
LRWSP	Long-Range Water Supply Plan
LT2	Long-Term 2 Enhanced Surface Water Treatment Rule
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
ME	meter equivalent
MG	million gallons
mgd	million gallons per day
NCSU	North Carolina State University
OWASA	Orange Water and Sewer Authority
PFAS	per and poly-fluoroalkyl substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
RCW	reclaimed water

RRA	Risk and Resilience Assessment
SCADA	Supervisory Control and Data Acquisition
TAWSMP	Triangle Area Water Supply Monitoring Project
TN	total nitrogen
TP	total phosphorus
TWP	Triangle Water Supply Partnership
µg/l	micrograms per liter
UCMR3	Unregulated Contaminant Monitoring Rule 3
UCMR4	Unregulated Contaminant Monitoring Rule 4
UNC	University of North Carolina at Chapel Hill
WHO	World Health Organization
WRF	Water Research Foundation
WSMPBA	Water and Sewer Management, Planning and Boundary Agreement
WTP	water treatment plant
WWTP	wastewater treatment plant

Background

Orange Water and Sewer Authority (OWASA) publishes this annual report to evaluate how well we are meeting our mission of providing our customers with high quality and reliable water, wastewater, and reclaimed water services through responsible and creative stewardship of the resources we manage.

This report summarizes observed trends for several indicators – such as customer growth and demands, water supply and drinking water treatment, wastewater treatment, use of reclaimed water, and environmental regulations – which are important factors that influence the need for, timing, and scope of our facilities planning and investment decisions. Thus, the information in this document is one item that shapes our Capital Improvements Program (CIP). Through the process of regularly reviewing, updating, and publishing this report, we strive to anticipate and proactively prepare for change so that we are better positioned to engage the community as we consider and decide on how best to sustainably meet service requirements for the foreseeable future.

The OWASA Board of Directors adopted a Strategic Plan in March 2014 and an update to the Strategic Plan in June 2016. The Strategic Plan identifies the key initiatives and corresponding actions OWASA will take to address the issues we believe are most important for the customers and community we serve. The June 2016 Strategic Plan stated that this Annual Review and Update of Strategic Trends and Utility Planning Issues (Strategic Trends report) would be modified to serve as a companion document to the Strategic Plan. The information provided in this report may be used to update or add initiatives to future updates of the Strategic Plan.

This Strategic Trends report begins with an overview of OWASA's planning environment which includes a description of those items which may impact the timing and scope of our facilities planning and investment decisions. It then includes a description of OWASA's main management areas beginning with source water protection; then raw water supply and treatment; distribution of drinking water to our customers; wastewater collection, treatment, and disposal or reuse. Each topic includes information on regulations, technology and research, energy management, links to the Strategic Plan, and follow-up actions.

OWASA's Planning Environment

This section describes the items in OWASA's planning environment that would impact the timing and scope of our facilities planning and investment decisions. Understanding these items ensures that we provide our customers with high quality and reliable water, wastewater, and reclaimed water services through responsible and creative stewardship of the resources we manage.

Service Area

The local governments in Orange County have developed several agreements to determine who has jurisdiction over certain areas and what areas are to be served by municipal water and sewer. These agreements help concentrate growth in compact municipal areas, preserve the rural character of the County, and limit urban sprawl. The area that OWASA can provide service to is shown in Figure 1 and is from the Water and Sewer Management, Planning and Boundary Agreement (WSMPBA) which was adopted in 2001 and amended in 2010 and 2017. The 2017 amendments included minor changes to the boundary along Smith Level Road. If changes are made to OWASA's service area, OWASA will need to ensure its resources and infrastructure will reliably meet the demands of those new areas along with the projected development within our current service area.

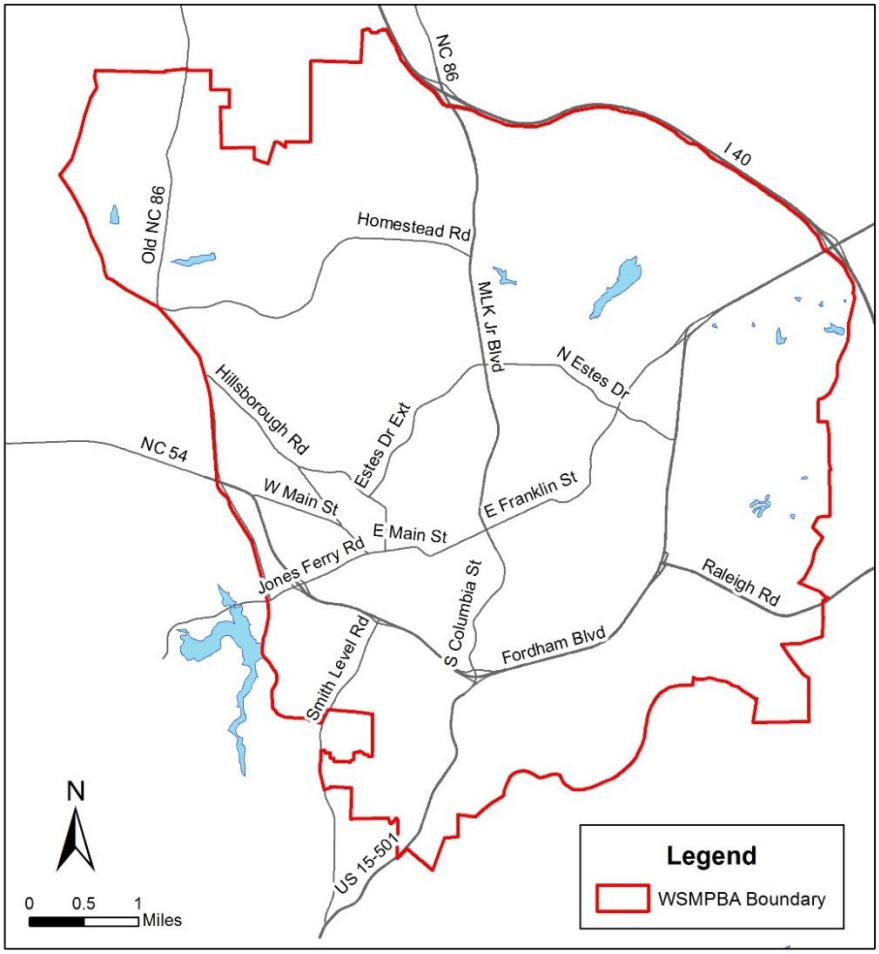


Figure 1. WSMPBA Boundary

Growth and Development

It is important to project when, where, and how much growth will occur, and what the subsequent demands will be on our water, wastewater, and reclaimed water services to ensure we have adequate capacity to meet the community's future needs. Figure 2 illustrates past population numbers for the Towns of Carrboro and Chapel Hill as well as the 2045 projected population based on regional transportation planning and the 2070 projected population as presented in the report titled *Long-Range Water Demand Projections Through 2070 for the Long-Range Water Supply Plan Update* presented to the Board of Directors in March 2019. These projections are similar to those provided during the State of the Community Report in September 2019; the projected 2050 population in Chapel Hill and Carrboro based on linear models is anticipated to be between 103,564 and 128,755. The projected 2050 population shown by the orange line in Figure 2 is 117,726 and 124,565 shown by the blue dotted line. These projections are all very similar.

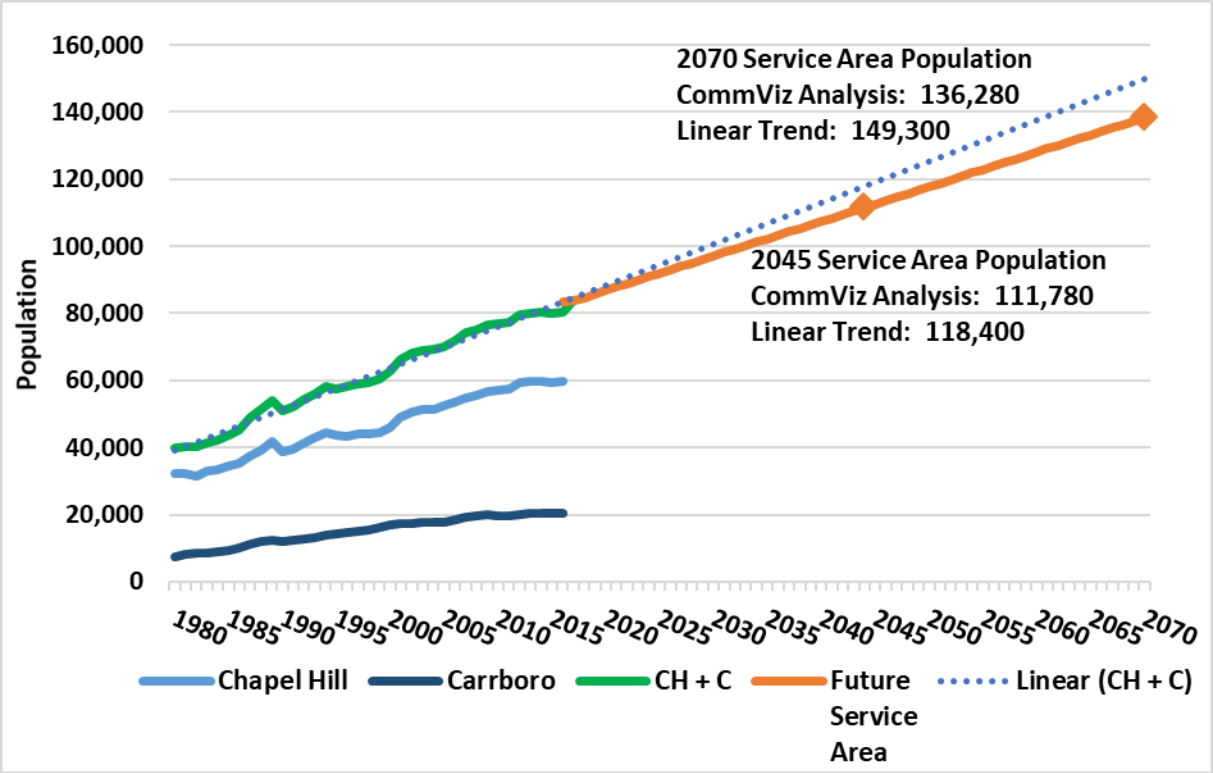


Figure 2. Population Projections - UNC is included in Town of Chapel Hill population projections

We anticipate that growth will continue to be higher density, with redevelopment and infill projects such as the Blue Hill District, Carolina Square, and Shelton Station, and with new development projects such as Carraway Village. Higher density development tends to result in lower per capita demands and may make better use of existing water and wastewater infrastructure. OWASA will use local government future growth information to ensure that the capacity of our water distribution system and wastewater collection system is sized appropriately.

Climate Change

OWASA's operations are intricately linked with the environment and weather, and climate change has the potential to significantly and directly impact various aspects of our business. Additionally, extreme weather events like drought and hurricanes have the potential to indirectly affect the supply of resources that we need to conduct business (i.e. power and chemicals), as well as the demand for our services. OWASA must be prepared to adapt to a changing climate, and we are incorporating climate change adaption into various aspects of our operations.

While experts believe, the southeastern United States will receive about the same amount of rainfall on average in the future, that rainfall will likely be provided in more severe storms and flooding events with more severe and prolonged droughts in between. This new pattern of rainfall will impact the yield of OWASA's and the region's reservoirs and the patterns of water demand including the water used for irrigation and cooling. As a result, OWASA and our utility neighbors must address the resiliency of water supply and storage, especially for periods of severe and extended droughts as well as the capacity of our reclaimed water system, which may face higher peak demands.

OWASA worked with our utility neighbors through the Jordan Lake Partnership (JLP) to develop the Triangle Regional Water Supply Plan to ensure all Partners have sufficient and reliable water supply through 2060. The JLP also contracted a regional interconnection study to evaluate the interconnection capacity of our drinking water systems and to identify needed infrastructure improvements to meet future needs. The JLP has been reorganized as the Triangle Water Supply Partnership (TWP). The TWP plans to build on the work of the JLP and use the interconnection model to run planning scenarios to identify strategies to improve the region's resiliency to planned and unplanned water supply challenges. OWASA is updating its Long-Range Water Supply Plan (LRWSP) to ensure we have water to meet our needs through 2070.

Our climate change planning to date has focused on drought management planning and natural disaster emergency preparedness. However, high rain events could result in greater flooding of our infrastructure. While our infrastructure has been designed to meet certain flood events, the frequency of those events could increase in the future. Recognizing this change in rainfall, OWASA is currently evaluating recent rainfall data and identifying a new design storm as part of our wastewater collection system model update. Hurricanes and other storms could damage critical infrastructure. OWASA plans for forecasted events, and coordinates emergency planning with our neighboring communities and other utility partners in North Carolina.

Climate change also has potential implications on the quality of the water in our reservoirs. With temperature change and impacts on rainfall, we could experience more frequent algal blooms in our reservoirs and potential increases in taste and odor events and cyanotoxin concentrations. (Cyanotoxins are toxins produced by blue-green algae and were responsible for the City of Toledo's "Do Not Use" warning in 2014.)

OWASA continues to monitor climate change science, and we participate in applied research projects with universities, other utilities, and other agencies where applicable, to proactively plan to meet the

community's water and wastewater needs in the face of increasing climate variability. Nonetheless, we would benefit as an organization and community to take a strategic approach to the impact of climate change on our overall mission that considers compounding situations and those that might fall just outside of obvious consideration. The Board of Directors may want to consider using climate change as a theme for its next Strategic Plan to prioritize the resources necessary to take a comprehensive approach to updating plans and procedures to be resilient against a changing climate.

Regulations

OWASA monitors the regulatory arena closely so we proactively ensure we can meet all legal requirements applicable to the provision of water, wastewater, and reclaimed water services to our customers. Many of these potential regulations would impact our drinking water supplies and treatment facilities. Potential regulations are included for trends where they are applicable in this Strategic Trends report.

Technology and Research

OWASA stays informed about advancements in technology and research, their capital and operating costs, and ability to better position us to provide services to our customers in a more sustainable manner. OWASA often partners with local university researchers, professional associations, and our consultants to obtain information on how emerging technologies may apply specifically to OWASA. Technologies that OWASA is monitoring are described in applicable sections with this Strategic Trends report. General information on our use of university research, professional associations, and consultants is provided below.

University Partnerships

OWASA often partners with our local universities to evaluate emerging technologies. We have provided water and wastewater samples to local universities to test emerging technologies. We have supported university classes by providing data. One effective use of university research is through our membership in the Urban Water Consortium, a group of twelve of the largest water utilities in the state. Together these twelve utilities pool their funds to bridge our research needs with university expertise. Some of the current research funded through this consortium is included in applicable sections of this report.

Professional Associations

OWASA is a member of various water and wastewater organizations, and our employees review their publications and attend their conferences. Staff regularly meet with other utility staff locally, throughout the southeast region, and nationally through these memberships; these contacts with other utility staff enable us to stay abreast of the latest technologies that work in our region to better meet our water, wastewater, and reclaimed water needs. Some of the industry trends noted by attending these conferences and interacting with staff from other utilities are:

- Renewal and replacement of aging infrastructure
- Asset management
- Conservation and reclaimed water to meet the needs of growing populations with existing water resources

- Public understanding of the value of water
- The need to attract, train, and retain staff and utility management and leadership
- Excellence in customer service and public awareness of water issues
- Cybersecurity
- Climate risk and resiliency
- Energy management
- Compounds of emerging concern

Several of the national organizations develop annual reports that often reiterate these industry trends and that we use to evaluate OWASA's practices:

- AWWA's State of the Water Industry Report – this report is based on an annual survey of utilities to identify and track challenges facing the water industry, provide data and analysis to support water professionals, and inform decision makers and the public of challenges facing the water industry
- AWWA's Benchmarking Report – AWWA summarizes performance results provided by water and wastewater utilities in quartiles. OWASA participates in AWWA's benchmarking surveys and has used the results of the Benchmarking Report as goals in several of the trends presented in this report.
- Association of Metropolitan Water Agencies (AMWA) Annual Report - this report is focused on regulatory and security issues, but AMWA also supports scientific research, collaboration, and sustainable utility practices
- The National Association of Clean Water Agencies, Water Environment Federation and Water Environment Research Foundation Water Resources Utility of the Future – this report was first developed in 2013 to recognize that water and wastewater utilities were identifying themselves as resource managers rather than waste managers. One trend that the latest Utility of the Future (2015) recognizes is that utilities in the United States are beginning to expand their use of technologies used in other countries. This 2015 report also notes how partnerships between utilities, consulting engineers, government, and finance are used to move utilities forward. This report has been replaced by the Utility of the Future Today Recognition Program. OWASA was recognized by this program for its organizational culture and energy efficiency programs.

The American Water Works Association (AWWA) sponsors the Partnership for Safe Water and the Partnership for Clean Water. The Partnership for Safe Water is a voluntary effort for water utilities to optimize their treatment and distribution system processes to help ensure the production and delivery of safe water to all users that go beyond regulatory measures. The OWASA Jones Ferry Water Treatment Plant was the ninth plant in the nation and first in North Carolina to achieve the highest level of recognition with the Phase IV Excellence in Water Treatment Award. This level of excellence has been maintained for seven years running. In 2016, OWASA received the Presidents award under the Partnership for Safe Water for its distribution system. The Partnership for Clean Water is a parallel program that focuses on wastewater treatment plant optimization, effluent quality and energy savings. This program was established in 2016 and is still under development. The OWASA Mason Farm

Wastewater Treatment Plant has begun the initial self-assessment phase with the goal of being one of the first plants in the nation to achieve the first level recognition with the Phase III Directors Award.

The Water Research Foundation (WRF) also maintains a website that summarizes current research on topics important to water utilities including per and poly-fluoroalkyl substances (PFAS), cyanotoxins, fluoride, and taste and odor.

The U.S. Environmental Protection Agency (EPA) and six major water and wastewater associations developed a Primer on Effective Utility Management which was written to guide utility managers to make effective changes to achieve excellence in meeting their core missions.

The State Water Infrastructure Authority was created by the North Carolina General Assembly in 2013 to assess and make recommendations about the water and wastewater infrastructure across the state. The Authority finalized the Infrastructure Master Plan in 2017. The report notes that in order for a water utility to be viable, it must exhibit best practices around infrastructure management, organizational management, and financial management. Staff regularly attend meetings with staff of the State Water Infrastructure Authority to stay updated on their recommendations.

Engineering Consultants

OWASA hires engineering firms to plan, design, and construct our infrastructure. These engineering firms design and construct similar infrastructure throughout the region and nation. We hire them for their expertise; based on our specific requirements and circumstances and their experiences with different technologies, they recommend technologies that will best meet our needs.

Other Important Utility Planning Issues

This section includes a brief overview of other utility planning issues in which OWASA is currently engaged which support our mission and the values included in the Strategic Plan. This section is not intended to be a comprehensive overview of utility planning issues.

Energy Management

Strategic Initiative Number 4 in OWASA's Strategic Plan is to implement an Energy Management Program. OWASA uses a lot of energy to operate our water, wastewater and reclaimed water facilities, protect the environment, and provide service to about 83,000 residents in the Carrboro-Chapel Hill community. In Calendar Year 2018, our facilities used about 67 billion BTUs of energy – enough to power about 1,800 homes for a year. That energy came at a cost of $1.2 million, comprising about 5% of our annual operating expenses in Fiscal Year 2019

1. In a move to improve our environmental impact, reduce a significant operating cost, and increase the resiliency of our organization, the OWASA Board of Directors established the following energy management goals and objectives. Reduce use of purchased electricity by 35 percent by the end of Calendar Year (CY) 2022 compared to CY 2010 baseline;
    a. Progress: In FY19, OWASA used 29% less electricity than in Calendar Year 2010.
2. Reduce use of purchased natural gas by 5 percent by CY 2020 compared to CY 2010 baseline;
    a. Progress: In FY19, OWASA used 43% less natural gas than in Calendar Year 2010.

3. Beneficially use all wastewater treatment plant (WWTP) biogas, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment and formally engage local governments and partners in discussion about potential development of a biogas-to-energy project at the Mason Farm WWTP
    a. Progress: We have determined that there is no cost-effective strategy that we can pursue on our own at this time. We are currently using half of the biogas in a boiler that heats anaerobic digesters (see progress on natural gas goal).

OWASA has an active Energy Management Program designed to systematically identify and evaluate energy management to achieve our objectives. We consider the social cost of carbon in evaluating economic efficiency. Our progress is a result of our investment in energy efficient equipment (blowers, pumps, drives, and motors), lighting, and HVAC units. It is also a result of our community's enhanced commitment to water conservation and efficiency. Less water use equals less energy use.

This Strategic Trends report includes information on electricity and natural gas use for OWASA's operations for trends where it is appropriate. We are not tracking vehicle fuel use by functional area and are not reporting that energy use in this Strategic Trends report.

In September 2019, the Board of Directors approved moving forward in a design process for the installation of solar panels on OWASA facilities to generate and use renewable energy. This project will help OWASA achieve its goal of reducing purchased electricity use by 35 percent by 2022 and reduce greenhouse gas emissions by over 800 metric tons per year. For further information on OWASA's Energy Management Program, please see our website.

Safety

Safety is the number one priority of every member of the OWASA team. We are dedicated to reducing injuries, accidents and ensuring compliance. We achieve this by fostering a culture focused on awareness and safe work methods and by providing high-quality training, comprehensive workplace evaluation and emergency response.

Staff continually evaluate methods to improve our processes. We routinely perform after action reviews following small and large events. The after action review process identifies what happened, what we set out to accomplish, what worked well, and where we can improve.

Much of the information contained in this Strategic Trends report helps us make sure that we are providing the community with safe drinking water and protecting both public health and the environment through proper conveyance, treatment, and disposal of wastewater.

Source Water Protection

Description

Our community has a long history of taking progressive actions to ensure the health and safety of our drinking water supplies. Since it began operations in 1977, OWASA has understood that to protect the water source, you must protect the watershed, and we have been actively involved in a wide range of watershed protection efforts, such as:

- Limits on the extension of water/sewer service into the Cane Creek Reservoir and University Lake watersheds;
- Support for comprehensive protection through zoning and land use controls;
- Restrictions on in-lake recreational activities;
- Special technical studies and educational activities; and
- **Land acquisition through the strategic purchase of property or conservation easements in areas determined to be critical for water quality protection**.
- Managing healthy forests

It is the land acquisition effort which is the focus of this section of the report. OWASA spent $7.8 million on land protection between 1991 and 2006 through purchase and conservation easements and grant funds covered $3.0 million of these costs. (Note: these costs have not been adjusted for inflation and do not reflect ancillary expenses for legal, survey, appraisals, other site work, or administrative costs of OWASA staff time).

Land acquisition was among the options evaluated in the University Lake watershed management study and plan commissioned in the late 1980s. Water quality modeling indicated that permanently protecting 2,900 acres (approximately 15 percent) of the watershed would have only slight water quality benefits and not justify the multi-million-dollar cost, but that selected land acquisition in critical areas of the watershed may be appropriate. This recommendation was later confirmed in a follow-up analysis, which found that land acquisition would probably not be effective, but a possible exception may apply to undeveloped land very near the lake, and that conservation easements along stream buffers would be particularly valuable near the downstream ends of tributaries as they approach University Lake.

Based on these technical recommendations, OWASA elected not to pursue a program of land or easement acquisition in the University Lake watershed, but to consider land preservation opportunities on a case-by-case basis. In 2006, OWASA purchased a 73-acre property along Morgan Creek immediately upstream of University Lake (with the help of a $1.2 million NC Clean Water Management Trust Fund grant). This property was placed under a permanent restrictive conservation easement that protects all riparian areas and greatly limits future development; subdivided into two large tracts; and re-sold on the open market in 2011 – with all restrictions in place.

The primary recommendations in a 1996 study of the Cane Creek Reservoir watershed included large lot (5 acres or greater) residential re-zoning and the permanent protection of 1,265 additional acres of

watershed land either through purchase of land or acquisition of conservation easements to limit development and protect critical riparian buffers. OWASA adopted those recommendations as goals for the protection of Cane Creek Reservoir and subsequently protected an estimated 1,075 acres of additional Cane Creek Reservoir watershed land through purchase or acquisition of conservation easements. Since 1997, Orange County's Land Legacy Program and other groups also acquired protective conservation easements on an additional 370 acres in the Cane Creek Reservoir watershed. Together, OWASA and Orange County's land protection efforts have exceeded OWASA's original goal. OWASA and Orange County staff continue to work closely in coordinating the needs of our respective programs as the County protects additional land in the watershed and elsewhere.

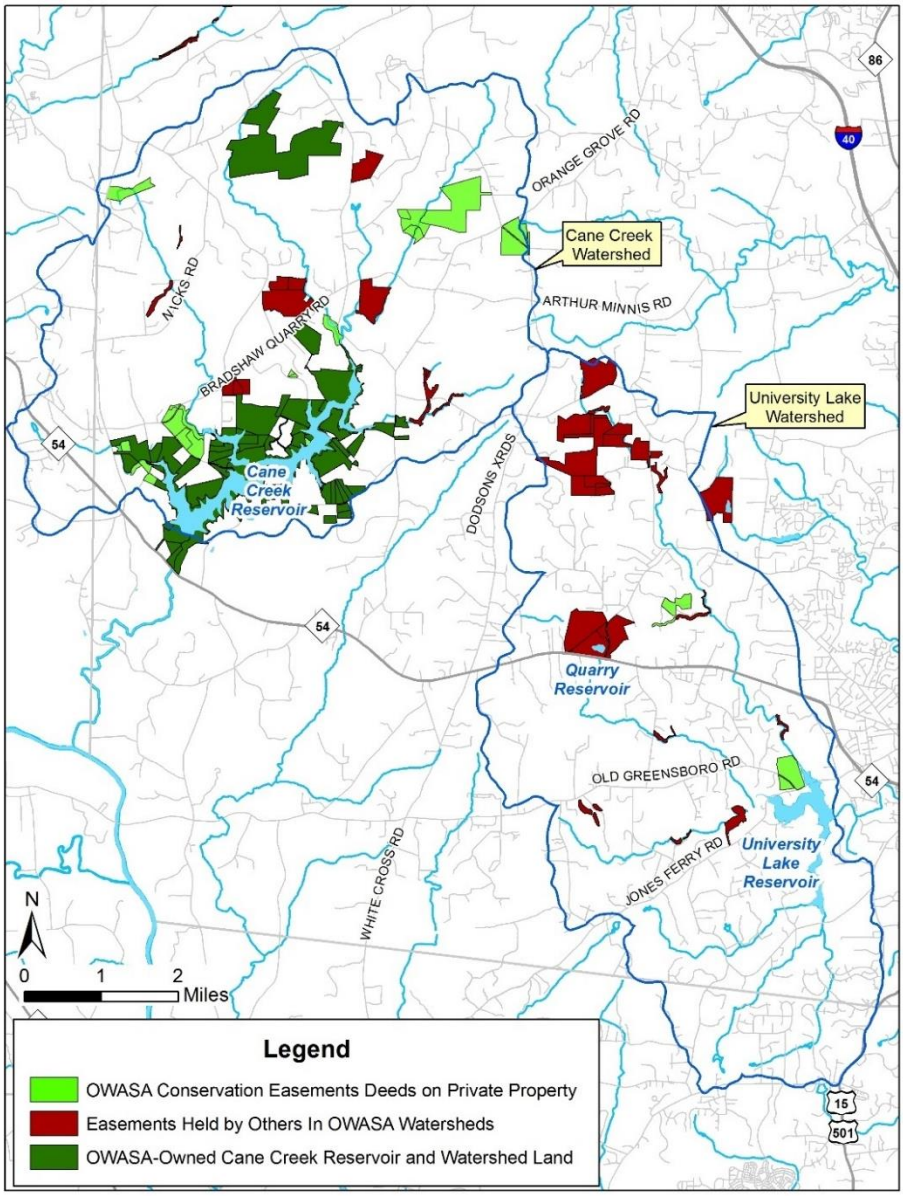


Figure 3. Protected Land in OWASA's Watersheds – Approximately 10 percent of our watershed lands are located outside Orange County, where less stringent controls apply.

Water Quality Monitoring

OWASA is a founding member of and actively participates in the Triangle Area Water Supply Monitoring Project (TAWSMP), which is an interlocal water quality monitoring and research implemented in collaboration with the US Geological Survey (USGS). This Partnership began in 1988. The TAWSMP samples area water supply reservoirs and some of their key tributaries to monitor water quality and parameters of emerging concern. The robust continuous dataset enables analysis and identification of trends in water quality. TAWSMP operates in multi-year phases. Scopes of work were developed for each phase of the TAWSMP which include parameters which remain the same from phase to phase such as nutrients, chlorophyll *a*, major ions, and total suspended solids as well as parameters of interest for that particular phase.

The USGS published Trends in Water Quality of Selected Streams and Reservoirs Used for Water Supply in the Triangle Area of North Carolina, 1989-2013 in July 2018. The USGS evaluated land cover, nutrients, and other parameters for statistical trends over the 25-year period. The results of that trend analysis were summarized in OWASA's 2018 Strategic Trends Report.

An important consideration for long-term watershed protection is how a changing climate may impact water supply water quality and potential treatment needs. Warmer temperatures and changing hydrology will impact the frequency, type and extent of algal blooms in our drinking water reservoirs, but there are several key unanswered questions. Will we need to install advanced treatment technologies in our WTP to reduce public health risk from algal toxins? Are there any effective in-lake management measures (such as mixing) that will reduce the frequency and severity of algal blooms and other water quality problems? What are the costs, effectiveness, and energy requirements of those measures? How are future declines in water quality likely to keep us from maximizing the reliable yield of our water supply reservoirs? Unfortunately, these are not questions that can be addressed by quickly evaluating water quality monitoring data on an annual basis. Staff have been in communication with university researchers who have expertise in characterizing algal blooms, and in particular, cyanobacteria (also sometimes called blue-green algae). These questions are not unique to OWASA, so we are reaching out to other utilities and agencies to explore opportunities to collaborate on targeted research to better understand and address these issues, perhaps through one or more of our existing partnerships, such as the Urban Water Consortium or the Triangle Water Supply Monitoring Program. The Board of Directors may also want to consider including these types of studies as an initiative in the next update of the Strategic Plan.

Regulations

- There is ongoing research at the federal and state level regarding per- and poly-fluoroalkyl substances (PFAS) in drinking water. PFAS are present throughout the environment because they are highly persistent and have been widely used for decades, including in industrial applications, household and consumer products, food packaging, and firefighting foams. GenX is one of the PFAS compounds that was found in the City of Wilmington's water supply. EPA has developed an Action Plan to address PFAS, which includes making a regulatory determination for two PFAS

(perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA)). The North Carolina General Assembly appropriated $5 million in Summer 2018 to test raw water at public water supplies across the state for PFAS and included air quality sampling since air emissions can transport PFAS in the environment. OWASA completed special monitoring for PFAS in our raw water, drinking water, Morgan Creek, and in our wastewater treatment plant effluent when researchers from Duke University found some of those substances in our drinking water. Further information was provided to the Board of Directors on February 22 and March 8, 2018. OWASA's Natural Resources and Technical Services Committee discussed PFAS and source water protection in November 2018 and recommended that staff monitor PFAS at our raw water intake at Cane Creek Reservoir and in the drinking water leaving our Jones Ferry road WTP quarterly for one year. A mid-year update of results was provided to the Board in June 2019.

- The Long Term 2 Enhanced Surface Water Treatment Rule (LT2) builds upon the 1996 amendment to the federal Safe Drinking Water Act to strengthen protection against microbial contaminants, especially *Cryptosporidium*. OWASA completed the first round of monitoring for *Cryptosporidium* and *E. coli* in our source waters in 2009. As a result of this monitoring, OWASA was placed in the lowest treatment category, which requires no additional treatment. Staff completed the second round of two years of monthly monitoring of Cane Creek Reservoir and University Lake in August 2017. Based on the round 2 results, OWASA remains in the lowest treatment category and will not be required to provide additional filtration treatment. Staff are in the process of conducting a round of monthly sampling of the Quarry Reservoir; this round will be completed January 2020.
- The EPA is requiring monitoring for some cyanotoxins by all large utilities and some small utilities. This monitoring is part of the Unregulated Contaminant Monitoring Rule (UCMR), which is the primary way the EPA gathers occurrence data on compounds it is considering regulating. OWASA will begin this monitoring in April 2020. Although this monitoring is occurring in the treated drinking water, raw water is the source of these compounds. Since 2016, OWASA has monitored for three cyanotoxins in our raw water, treated drinking water, and within our treatment process.
- OWASA follows developments regarding pharmaceuticals and personal care products in drinking water, wastewater, and reclaimed water. These products enter wastewater systems through excretion, disposal of unused medicine in sinks or toilets, and personal care products washed from skin and hair. They can also be present in runoff from livestock operations and subsurface discharges from-site wastewater systems (septic tanks). Cane Creek Reservoir and University Lake watersheds are highly protected, and no treated municipal or industrial wastewater is discharged within our local water supply watersheds. However, there are livestock operations, private septic systems, and biosolids applications in both watersheds. A 2007 study by the U.S. Geological Survey of local untreated (or raw) water sources including Cane Creek Reservoir and University Lake tested for pharmaceuticals. In this study, one pharmaceutical (acetaminophen) was detected in one sample from Cane Creek Reservoir; all other results from OWASA reservoirs were below the detectable levels. OWASA does participate in EPA monitoring efforts of unregulated contaminants. This tool is used to improve drinking water quality standards by collecting data on compounds that are suspected to be present in drinking water, but do not yet have health-based

standards set under the Safe Drinking Water Act. Pharmaceuticals and personal care products have not been included in this program to date, and there are no federal requirements for them.

- In accordance with direction from EPA, the North Carolina Department of Environmental Quality (DEQ) is developing draft nutrient criteria for surface waters in the state. If nutrient levels in one or more of our water supply reservoirs, Morgan Creek, and/or other surface waters in our area exceed future nutrient-related water quality limits, we and/or other parties could be required to take action to reduce the discharge of nutrients into those water bodies. The technical, economic, and environmental feasibility of complying with such requirements can only be determined once proposed criteria are issued.
- The North Carolina General Assembly ratified House Bill 894 to improve Source Water Protection in August 2014 in response to the accidental release of 4-methylcyclohexanemethanol in West Virginia and the coal ash spills in North Carolina. Subsequently, the North Carolina Environmental Management Commission (EMC) adopted rules that require all public water supplies which use surface water to develop a source water protection plan. OWASA is well positioned to meet the requirements of these rules; our plan is due on January 1, 2023.
- America's Water Infrastructure Act (AWIA) requires water systems to prepare a risk and resilience assessment (RRA) and a subsequent emergency response plan (ERP). The RRA is to evaluate risks from natural hazards and malevolent acts, the resilience of source water, treatment, and conveyance facilities, monitoring, and financial infrastructure. The ERP evaluates strategies to improve the resiliency of the system including physical and cyber security, requires procedures to implement to respond to natural hazard or malevolent act, and practices that can reduce the impact of an event. The requirements of North Carolina's Source Water Protection program roll into these federal requirements. OWASA is required to prepare its RRA by December 31, 2020 and the ERP must be developed and certified within six months of submitting the RRA certification.

Technology and Research

- We are a partner in a recently completed study to evaluate the effectiveness of artificial mixing as a strategy to improve reservoir water quality. Current research suggests this technology may work well for some smaller reservoirs and lake areas near intake structure. Researchers at North Carolina State University (NCSU) evaluated the effectiveness of artificial mixing in Piedmont reservoirs accounting for factors such as depth, temperature, wind, and nutrient concentrations. OWASA supported this research and provided data from University Lake as a control (does not employ artificial mixing) for the study. This study will help staff evaluate whether in-lake mixing may reduce algal blooms and the resulting increases in taste and odor events and potential cyanotoxin concentrations. The City of High Point employs artificial mixing in its two water supply reservoirs City Lake and Oak Hollow Lake to improve treatability of its drinking water. The Town of Cary recently began mixing Jordan Lake water near its intake. OWASA staff just received the final report from this research and are evaluating its potential application to OWASA.
- OWASA worked with researchers at NCSU to monitor cyanotoxin trends in both reservoirs using a method that integrates cyanotoxin levels over two to four week periods of time. This method allows for constant monitoring of cyanotoxin trends at the intake structures and will provide valuable

baseline data on the cyanotoxin concentrations coming into the plant. This work is being coordinated with the research into artificial mixing described above. Together these efforts will provide OWASA with valuable information about the frequency and concentration of cyanotoxins and potentially the conditions in our lake where they may be a concern. Occurrence and abundance data for algae and cyanobacteria, paired with grab sample data for cyanotoxins and removal through the treatment process will inform future treatment technology enhancements. A final report is expected soon.

- The 2016 General Assembly directed the UNC Collaboratory to evaluate water quality and nutrient management strategies in the Jordan and Falls Lake watersheds. These studies could result in new management strategies in the Jordan Lake watershed which could impact OWASA operations. Staff stay updated on the work of the Collaboratory and have provided data to some of the researchers.

Energy Management

Energy use to manage OWASA's lands is minimal and consists of fuel needed for travel and equipment to manage the land.

Strategic Plan Elements

Strategic Initiative 6 includes a goal that states "Land assets provide the expected value to fulfill OWASA's mission and the assets are effectively managed". The Board of Directors recently approved an incremental approach to managing our forests; healthy forests help protect long-term water quality in the reservoir.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Since OWASA met its watershed protection goals for land acquisition, we are not actively seeking or funding additional land conservation. However, we will continue to evaluate cost-effective land acquisition opportunities through conservation easements or purchase when available.	Ongoing	X	
2. Consider updating 1996 Cane Creek Reservoir Watershed Study	After completion of LRWSP and as part of next Strategic Plan	X (as part of budget)	
3. Inspect conservation easements on private land to make sure owners are following the terms of the easement	Annually		X
4. Develop AWIA RRA and ERP	Dec 2020 for AWIA and approx. June 2021 for ERP		X
5. Develop Source Water Protection Plan as required by DEQ	Due 1/1/2023	X	
6. Evaluate data from NCSU studies when completed and identify any follow up steps or recommendations for future.	CY 2019		X
7. Complete quarterly sampling for PFAS at Cane Creek Reservoir intake and in drinking water leaving plant. Evaluate data and identify any next steps.	CY 2019		X

Raw Water Supply and Long-Range Water Supply Plan

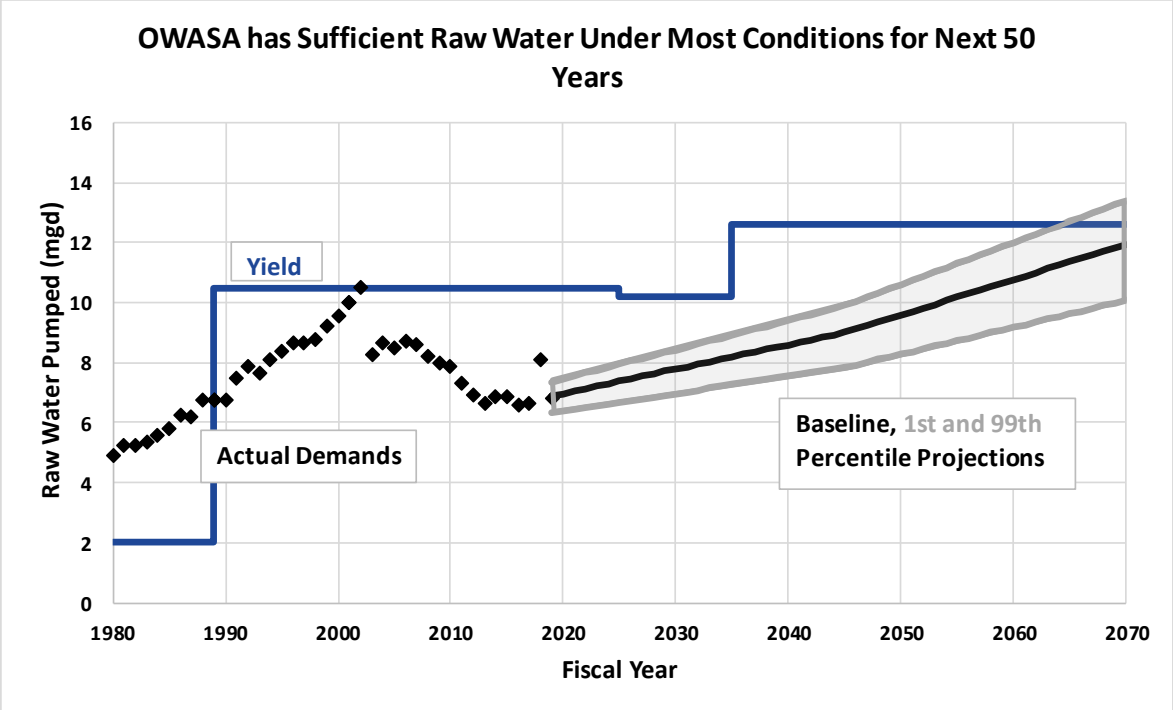


Figure 4. OWASA's Water Supply Yield and Demands

Description: This trend evaluates the supply (reliable yield) of our locally-owned upland water sources – Cane Creek Reservoir, University Lake, and the Quarry Reservoir – and historic raw water demands and estimated future raw water demands. (Since we do not have permanent facilities and/or agreements in place to access Jordan Lake, Figure 4 does not include our Level I Jordan Lake water storage allocation of about 5 million gallons per day (mgd). We can access this allocation through Town of Cary and City of Durham on a limited, emergency basis.)

Key Observations:

- Raw water demand increased in 2018, but we provided water to the City of Durham while they were working on their WTPs. If we had not transferred this water, our average raw water demand would have been approximately 6.9 mgd, the same level it was in FY 15 and FY 19.
- The annual average-day amount of water we pumped from reservoirs has declined substantially since peaking in FY 2002.
- Annual average-day raw water demands are now at the same level they were in the early-1990s, shortly after Cane Creek Reservoir was placed into service. This has occurred despite over a 60 percent increase in the number of customer accounts during that period.
- Key factors in the reduction in water withdrawal rates include:
    - Increased water use efficiency and conservation by our customers;
    - Conservation pricing and conservation ordinances, including year-round restrictions;

- Implementation of a process water recycling system at the drinking water treatment plant (2002), which reduced annual average-day raw water withdrawals by about seven percent;
- Implementation of the reclaimed water system in partnership with UNC (2009), which now meets over eleven percent of the community's annual average-day water needs.
- Higher density development which typically results in lower per capita demands.

- OWASA is updating its Long-Range Water Supply Plan (LRWSP), and Figure 4 shows the updated raw water demand projections developed as part of that project. Because we know that there is a lot of uncertainty when projecting growth and water demands 50 years, we developed a range of projections as shown by the grey lines in Figure 4; these represent the 1st and 99th percentile projections that resulted when we varied assumptions and ran the model 5000 times.
- We anticipate that OWASA's current and planned locally-controlled water supply sources will meet most customer demands through the next thirty to forty years and under most circumstances over the next 50 years.
- We anticipate that Jordan Lake, an alternative source, and/or additional demand management measures are expected to be needed to reduce risk to acceptable levels.

Regulations

Regulations concerning our raw water supply are described in the Source Water Protection section.

Technology and Research

Information on technology and research concerning our raw water supply is included in the Source Water Protection section of this report.

Energy Management

As shown in Figure 5, total kilowatt-hours (kWh) of electricity used to pump our raw water to the treatment plant was 13 percent less in 2018 than in 2010. Energy use for raw water pumped increased between 2016 and 2017, and again between 2017 and 2018. This increase is a result of providing the City of Durham with over 495 million gallons of finished drinking water (120 million gallons in 2017 and another 375 million gallons in 2018). OWASA provided this finished drinking water to the City of Durham at their request while they conducted maintenance on their two drinking water plants. 375 million gallons is equivalent to about two months of OWASA's typical demand. The additional energy required to pump an additional 375 million gallons of raw water increased our energy use for raw water pumping by an estimated 464,000 kWh. Without this additional demand, our energy use to pump raw water to the treatment plant would have been 29% less in 2018 than in 2010.

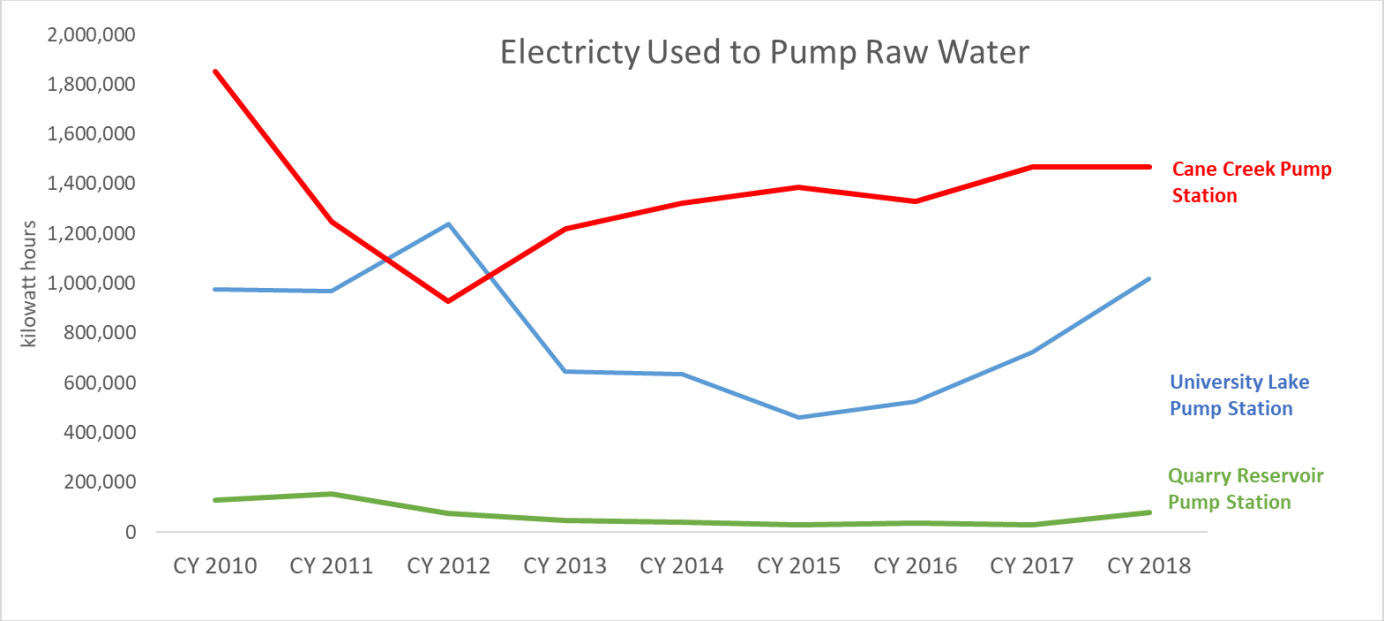


Figure 5. Electricity Used to Pump Raw Water

The 2019 Energy Management Plan Update identified three upcoming Capital Improvement Projects that have potential to further decrease the amount of energy used for raw water pumping: University Lake Pump Station Improvement project (270-11; expected completion date in FY 2020), the Cane Creek Raw Water Transmission Main study (271-05; expected completion date in FY 2021), and the Cane Creek Pump Station Improvement project (270-16; expected completion date in FY 2023).

Strategic Plan Elements

This trend is directly related to updating the LRWSP, Strategic Initiative 1. Updating the LRWSP will also engage the community (Strategic Initiative 2), and the technology of advanced metering infrastructure (AMI, Strategic Initiative 5) may help detect and address leaks sooner which would reduce raw water demand. It also is related to Strategic Initiative 3 in that we want to invest in any new water supply at the right time to sustain the community's drinking water supply.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. In future years, update calculations to estimate yield and estimate raw water demand projections when warranted (e.g., when new drought of record occurs [impacts yield], service area boundaries change, local governments or UNC revise growth projections).	Review when warranted – likely every 5 to 10 years	X (as part of LRWSP update)	
2. Continue to proactively plan and account for uncertainty, including increasing climate variability, through a diversified water supply and demand management portfolio.	Ongoing – currently evaluating supply and demand management alternatives as part of LRWSP update	X (as part of LRWSP update)	
3. Continue to partner with neighboring utilities to evaluate a potential new intake and WTP on the west side of Jordan Lake.	Ongoing (Participated in Jordan Lake West Facilities Feasibility Study in 2015 and Economic Feasibility Study in 2018)	X	
4. Once we have a better understanding of the potential cost to ensure access to our Jordan Lake water allocation, review and reconsider the advantages and disadvantages of other feasible supply and demand management alternatives as part of update of the LRWSP.	Now through spring 2020	X (as part of LRWSP update)	
5. Identify potential energy savings opportunities for raw water pumping in Energy Management Program.	Ongoing	X (as part of Energy Mgmt Plan)	

Quarry Reservoir Storage Volume

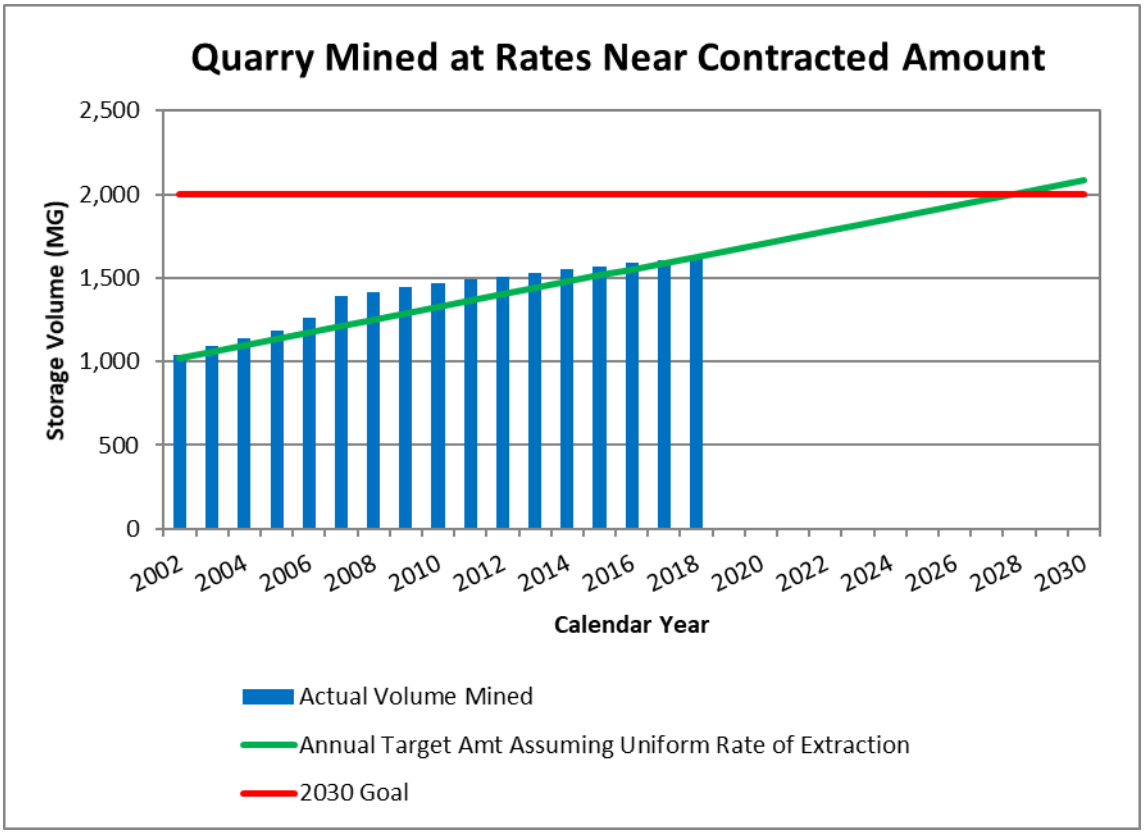


Figure 6. Quarry Mining Rates

Description: In accordance with an agreement with OWASA, Martin Marietta (formerly American Stone Company) is mining rock from OWASA-owned land adjacent to our Quarry Reservoir. Per that agreement and the requirements of Orange County's Special Use Permit that authorized expansion of the quarry, mining operations must cease by 2030, after which OWASA will begin to fill the expanded quarry with water. Martin Marietta is required to remove enough stone to ensure the expanded quarry (including OWASA's existing Quarry Reservoir at 0.2 billion gallons (BG)) will store at least 2.2 BG of water. This trend evaluates whether the quarry is being mined at rates which will meet that minimum water storage capacity requirement.

Key Observations:

- The quarry is being mined at rates which meet the contractual requirements.

Regulations

There are no regulations to report for the quarry. However, OWASA will perform microbial monitoring on the expanded Quarry Reservoir as soon as it is put into service, and DEQ may need to approve it as a water supply source. Staff is in the process of conducting LT2 monitoring of the Quarry Reservoir.

Technology and Research

There are no updates in technology to report for the quarry.

Energy Management

The existing Quarry Reservoir is used only during extreme droughts or other emergencies. We periodically test the pumps to ensure they are ready in time of need. As a result, our energy use at the Quarry Reservoir is negligible (see Raw Water Supply and Long-Range Water Supply Plan trend).

Strategic Plan Elements

The Quarry Reservoir is an essential part of OWASA's water supply portfolio and is tied to Strategic Initiative 1, "Provide reliable and high quality supply of water for the next 50 years".

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to monitor the annual rate of rock excavation at the quarry to ensure contractual requirements are met.	Annual		X
2. Maintain and follow the Quarry Reservoir implementation checklist in order to ensure timely implementation of the Quarry Reservoir water storage project once mining ceases in 2030.	Ongoing		X
3. As part of LRWSP update, evaluate the benefits and costs of various Quarry Reservoir alternatives (e.g., developing permanent pump station to withdraw deeper water).	4th qtr CY 2019 – early CY 2020	X (as part of LRWSP update)	
4. Begin draining existing Quarry Reservoir to enable Martin Marietta to connect the current mine site with the existing Quarry Reservoir.	CY 2025		X

Water Treatment Plant: Peak-Day Drinking Water Demands

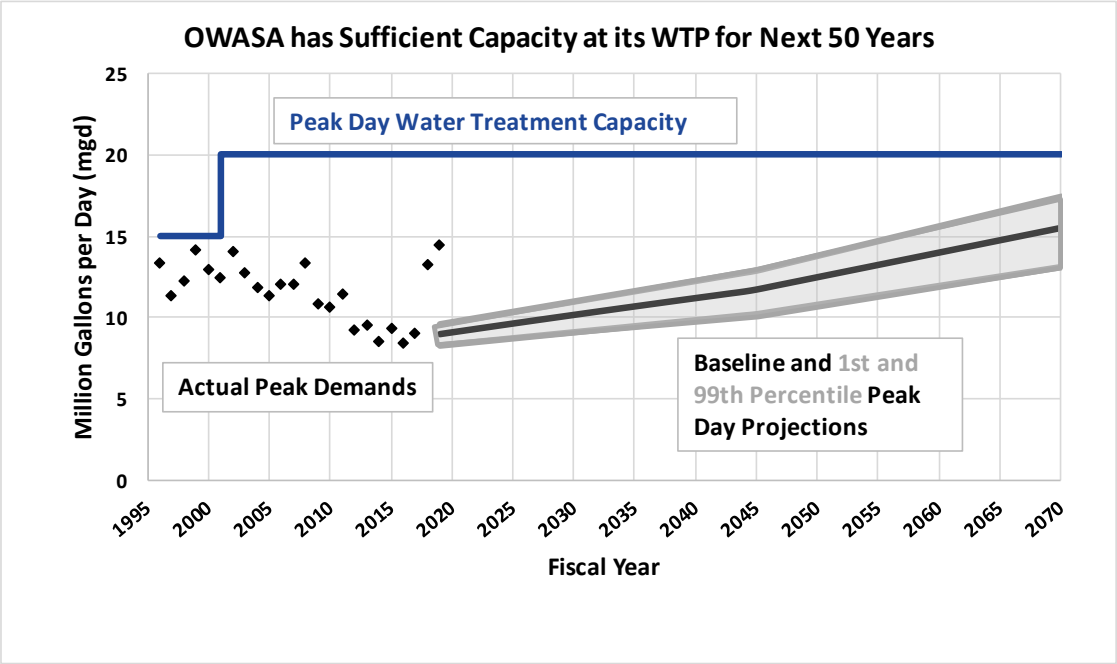


Figure 7. WTP Capacity and Peak Day Drinking Water Demands

Description: This trend evaluates peak-day drinking water demands and compares those demands to the 20 mgd rated capacity of the Jones Ferry Road Water Treatment Plant (WTP).

Key Observations:

- There was a significant increase in peak day drinking water demands in FY 2018 and FY 2019 compared to the recent past. OWASA provided drinking water to Durham while they had one WTP offline in FY 2018 and were making improvements at their second WTP; we provided some water to Durham in FY 2019 as well. The reason for the increased peak day in FY 2019 was the water main break on November 5, 2018. If OWASA had not had the main break, our peak day demand would have been 8.6 mgd, comparable to earlier years.
- Since FY 1999, the year with the highest peak-day demand, peak-day drinking water demands have declined by 39 percent (when accounting for the water main break) despite a 31 percent increase in customer accounts over that same period.
- This decline has resulted from the following primary factors: (1) our customers are using water more efficiently, (2) we have adopted conservation pricing and conservation ordinances including year-round water use restrictions, and (3) since March 2009, reclaimed water has been used instead of drinking water to meet certain non-drinking water needs at several UNC facilities that have high summer season demands (cooling towers and irrigation).
- The peak day drinking water demands indicate that we have adequate capacity in our WTP for the next 50 years even when accounting for uncertainty in our demand projections.

(NOTE: The observations presented above assume that the reclaimed water system is in service throughout the peak-day demand season. Peak-day drinking water demands would be considerably greater if the reclaimed water system is out-of-service.)

Regulations

- The 1996 amendments to the federal Safe Drinking Water Act require that monitoring be completed for a list of unregulated contaminants every five years. EPA will use the data collected to determine if any of these contaminants should be regulated. In May 2012, EPA published the rule to complete the third round of this monitoring (UCMR3); monitoring was staggered among facilities and all monitoring was completed by December 2015 with all results reported to EPA by summer 2016. OWASA participated in the Assessment Monitoring of 21 contaminants under the UCMR3 and completed monitoring in August 2014. Some larger utilities also monitored other emerging contaminants such as human and veterinary hormones. OWASA UCMR3 monitoring results consistently detected the following three unregulated contaminants: Chromium-6, Strontium, and Chlorate (see next bullets). In December, 2016 the EPA published the rule for the 4th round of this monitoring (UCMR4) requiring monitoring for 30 parameters including cyanotoxins, pesticides, and disinfection by-products. UCMR4 monitoring is occurring between 2018 and 2020. OWASA began monitoring in August 2019.
- EPA has set the maximum contaminant level (MCL) of total chromium (i.e., all forms of chromium) at 100 µg/L but has not yet published a drinking water standard for Chromium-6. The State of California adopted a Chromium-6 MCL of 10 µg/L, which became effective on July 1, 2014; but on May 31, 2017 the Superior Court of Sacramento County issued a judgment invalidating the MCL and ordering the State to adopt a new MCL. During the UCMR3, OWASA's monitoring for Chromium-6 detected levels between < 0.03 - 0.06 µg/L, which are well below the now invalid California standard. OWASA and other members of the TAWSMP identified Chromium-6 as a focus area for the current phase of water supply monitoring (see Source Water Protection section for a brief overview of the TAWSMP). As such, the US Geological Survey collected bi-monthly samples in our raw water supply beginning in August 2017. This monitoring was discontinued in August 2019 due to the very low number of detects and decision of the group that the resources could be better allocated. Analysis of data are ongoing.
- EPA has not yet published a drinking water standard for Strontium, but has established a health advisory level of 1,500 µg/L. A health advisory level is a non-enforceable, non-regulatory federal guidance which describes the concentration which can be consumed with little or no risk to health. OWASA's monitoring for Strontium detected levels between 53 - 75 µg/L, well under the health advisory level.
- EPA has not yet published a drinking water standard for Chlorate. The health advisory level for Chlorate is 210 µg/L. OWASA's monitoring for Chlorate during UCMR3 detected levels between 160 – 650 µg/L. The State of California has not set an MCL for Chlorate but has set a notification level of 800 µg/L. The World Health Organization (WHO) guideline for Chlorate is 700 µg/L. Chlorate is known to occur in drinking water as a result of the disinfection process and as a result of sodium hypochlorite (bleach) degradation. Concentration, long storage times, and temperature all

contribute to the degradation of sodium hypochlorite. Following UCMR3, OWASA changed the concentration and reduced storage times of our bulk sodium hypochlorite. OWASA completed a two-year study to test the Chlorate levels of our treated drinking water leaving the WTP and in the distribution system quarterly since implementing these changes and Chlorate levels have decreased by an average of 64 percent compared to levels measured as part of UCMR3. OWASA will continue to follow this issue to ensure its drinking water continues to be safe for its customers.

- EPA has not yet published a drinking water standard for Perchlorate, but in June 2019 published a notice of proposed rulemaking seeking public comment on a proposed MCL and maximum contaminant level goal (MCLG) of 56 µg/L as well as three alternative regulatory options (18 µg/L, 90 µg/L, and withdrawal of the agency's 2011 determination to regulate perchlorate). Based on litigation involving the Natural Resources Defense Council, there is a court-ordered deadline to have a standard by December 2019; EPA recently filed a motion seeking a six-month extension of that deadline. The EPA health advisory for Perchlorate is 15 µg/L, effective October 2008, and California adopted a standard of 6 µg/L, effective October 2007. Massachusetts adopted a drinking water standard of 2 µg/L. OWASA has tested for Perchlorate several times. Perchlorate was not detected in samples collected in 2001-2 as part of UCMR1, but the detection limit was 4 µg/L. In 2011, the level of Perchlorate was 0.33 µg/L in the finished water and in 2019 the level was below the detectable level of 0.05 µg/L in the finished water, well below the proposed regulatory limit and alternative limits as well as the advisory level and California and Massachusetts standards.
- PFAS are a family of compounds containing fluorine and carbon. In 2016, EPA published a new lifetime health advisory for two of these compounds, Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS), of 0.07 µg/L for a combined concentration of PFOA and PFOS in drinking water. This level of 0.07 µg/L was set to protect the most sensitive populations over a lifetime of exposure to the two contaminants. OWASA monitored for these substances in our treated drinking water as part of UCMR3; PFOA concentrations ranged from <0.02 µg/L to 0.03 µg/L, and PFOS was not detected. OWASA subsequently tested all our water supplies and our treated drinking water for a suite of PFAS in 2018. In light of these results, OWASA is continuing to sample our treated drinking water and raw water from Cane Creek Reservoir quarterly in 2019. Our use of powdered activated carbon in our treatment process remains effective at removing some but not all of these compounds. Levels of PFOS and PFOA remain well below the health advisory level. The EPA has committed to making a regulatory determination for these two compounds by the end of 2019.
- OWASA has historically met all disinfection by-product criteria applicable to finished drinking water provided to our customers. Monitoring data indicates that we should continue to meet any criteria developed for disinfection by-products. Additionally, two groups of currently unregulated disinfection by-products are included in UCMR4.
- Cyanotoxins are toxins produced by cyanobacteria (also sometimes called blue-green algae) under certain conditions. These toxins can be harmful to the environment, animals, and human health; one was responsible for the City of Toledo's "Do Not Use" warning in summer 2014. In June 2015, EPA issued health advisories for two cyanotoxins: microcystin (1.6 micrograms per liter [µg/L] for children 6 and up and adults and 0.3 µg/L for children less than 6 years old) and cylindrospermopsin (3.0 µg/L for children 6 and up and adults and 0.7 µg/L for children less than 6 years old).

Establishing a monitoring program and benchmarks for when source and/or finished water should be analyzed for toxins provides a solid foundation for a cyanotoxin management approach. OWASA has proactively been monitoring algal cyanotoxins since 2007 in our finished drinking water using a contract laboratory when our cyanobacteria counts rise above 100,000 units/mL in the blend of University Lake and Cane Creek Reservoir being treated. Additionally, beginning in the summer of 2016 staff began monitoring cyanotoxin levels at the intakes and through the treatment process on a weekly basis to gather baseline data on occurrence and removal. To date, OWASA has not exceeded the health advisory levels in our finished drinking water. In addition to microcystin and cylindrospermopson, OWASA also monitors for anatoxin-a. Staff will continue to evaluate algal toxins (additional information provided in Treatment Technology section). OWASA will be required to monitor for some cyanotoxins as part of UCMR4 beginning in April 2020.

- Manganese is being monitored as part of UCMR4 and may be regulated in the future. At this time, there is a secondary MCL, which is based on aesthetic concerns such as taste and discoloration not health effects, of 0.05 mg/L. Additionally, there is a non-regulatory 10-day health advisory limit (based on short-term exposure for infants) for manganese of 0.3 mg/L. OWASA has tested annually for manganese and results are consistently below the detection limit of 0.01 mg/L. Manganese does occur naturally in our reservoirs and the levels can be quite high. Because there are high levels in our source water, it would be possible for our treated water to exceed regulations. However, our treatment process is effective at removing this metal. Manganese is insoluble in its oxidized form. Both permanganate and chlorine are strong oxidants that help remove manganese from our water during the treatment process.

Technology and Research

- In 2017, there were several incidents where OWASA's drinking water had taste and odor issues. While taste and odor compounds in the drinking water are not harmful, they are not pleasant. OWASA purchased and started using a gas chromatograph/mass spectrometer in March 2019 which enables staff to test for the compounds in-house and receive results the same day or next morning. This has enabled us to swiftly adjust our treatment in response to higher levels of taste and odor compounds in our reservoir thereby assuring aesthetically pleasing drinking water for our customers. This equipment will also be useful for screening for other compounds of emerging concern.
- OWASA evaluates the treatment technologies at our WTP to ensure we can meet any potential upcoming standards with current treatment technologies. OWASA can meet most of the potential standards discussed in the Regulations section. Staff continues to follow on-going research on this topic to ensure safe drinking water for our customers.
- Staff periodically evaluate the chemicals we use at the plant to ensure we are using the best available in terms of meeting our treatment goals in the most sustainable manner as well as to ensure that we do not foresee shortages in chemicals we use which could impact treatment or their price. At this time, staff believe we are using the correct blend of chemicals and no shortages are foreseen in their supply.

Energy Management

In 2018, we used five percent less electricity at the Jones Ferry Road Water Treatment Plant (WTP) than we did in 2010. As with the energy use for raw water pumping, we used more electricity than we would have because we treated and pumped an additional 375 million gallons of treated drinking water for the City of Durham. Ultimately, this increased our use of electricity by over 213,000 kWh in 2018.

Without this additional water demand, we would have used 11 percent less electricity at the WTP than in 2010. This is in large part due to the conservation and efficiency of our customers, as well as UNC's use of reclaimed water. In addition, in early 2018, we completed an almost complete retrofit of all lighting to LED technology.

Natural gas is used at the WTP to heat buildings, and our use of natural gas is largely driven by weather. The use of natural gas (therms) was about five percent higher in 2018 than it was in 2010, largely attributable to weather and operational changes.

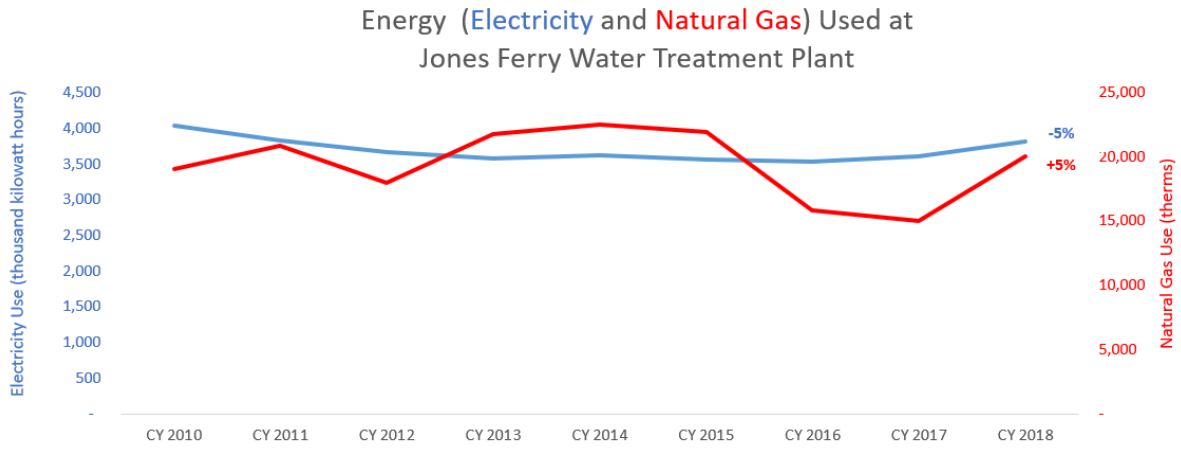


Figure 8. Energy Use at the Jones Ferry Road WTP

Strategic Plan Elements

Strategic Initiative 1 includes preparing a Water Conservation Plan. Conserving water will help reduce peak day and average day demands. Ultimately, the Water Conservation Plan will serve as a compilation of water conservation strategies identified in three separate OWASA plans:

- Strategies that effectively and efficiently delay or prevent the need for supply side expansion in order to meet the demands of a growing community (as evaluated and identified in the forthcoming Long-Range Water Supply Plan)
- Strategies that extend limited water supplies in times of drought (as identified in the Water Shortage Response Plan)
- Strategies that promote a community-wide water conservation ethos (as identified in the Strategic Communications Plan)

In addition, Strategic Initiative 3 includes a goal to invest at the right time in our community's water assets. Understanding the capacity of our WTP, the demands placed on it, and the potential implications of future treatment requirements will inform our CIP.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to monitor peak-day demands at the Jones Ferry Road WTP and identify cost-effective practices that could be implemented to further reduce peak-day demands.	Underway	X (as part of LRWSP)	
2. Continue to identify and pursue cost-effective opportunities for additional conservation or reclaimed water use, which help reduce peak demands.	Underway	X (as part of LRWSP)	
3. Continue to monitor potential growth in our service area by working closely with Carrboro, Chapel Hill, and UNC to ensure we have sufficient drinking water treatment, pumping and storage capacity.	Ongoing		X
4. Continue to monitor our water and stay current with the potential new drinking water standards to ensure we can meet future requirements. Identify any studies or technologies needed to ensure we provide safe, high quality drinking water to our customers.	Ongoing		X
5. Continue to monitor treatment technologies and chemical use for potential to improve our level of service.	Ongoing		X
6. Identify potential energy savings opportunities for water treatment and pumping in Energy Management Program.	Ongoing	X (as part of Energy Mgmt Plan)	
7. Maintain certification by Partnership for Safe Water (see chapter on "OWASA's Planning Environment") for Phase IV Excellence in Water Treatment	Ongoing		X

Cumulative Number of Water Meter Equivalents (MEs)

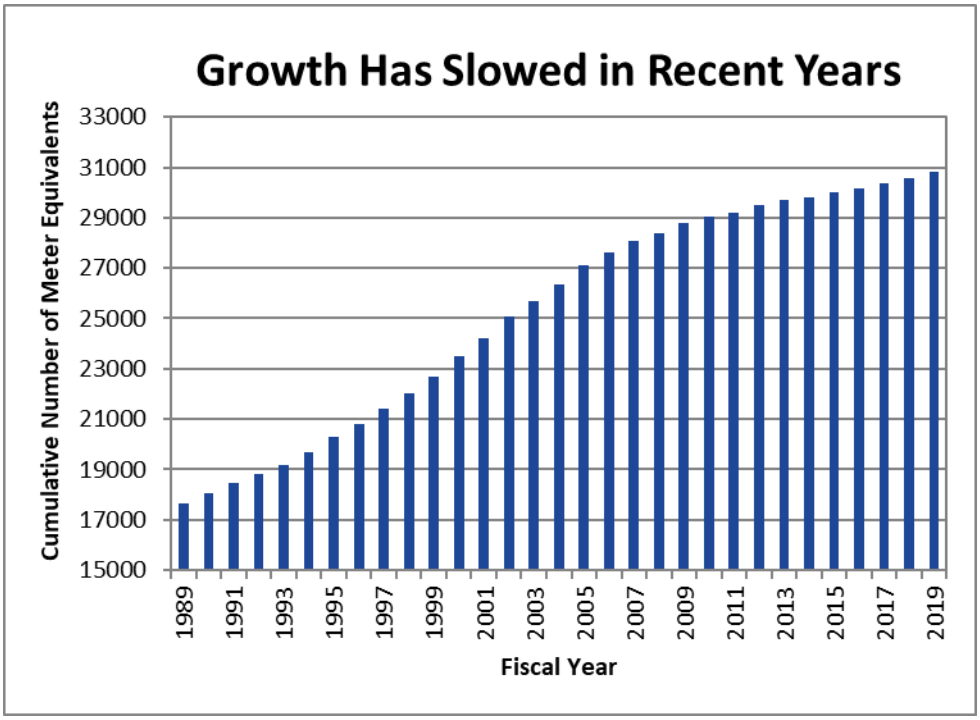


Figure 9. Number of Meter Equivalents Served by OWASA

Description: This trend evaluates the number of meter equivalents (MEs) served by OWASA. The smallest meters (5/8-inch) serve single family homes and small non-residential customers, while larger meters are used to serve locations with larger water demands. The capacities of larger meters are expressed in hydraulic capacity proportional equivalents of a 5/8-inch meter, or "meter equivalent". (For example, a 2-inch meter has a meter hydraulic capacity ratio of 8 MEs, and a 6-inch meter has an equivalency of 50 MEs.) The number of meter equivalents is an indicator of the potential rate of growth in customer demands the service area.

Key Observations

- Growth in the service area is slower in recent years than in past.
- The number of meter equivalents has grown 36 percent since FY 1999, the year with our highest peak-day drinking water demands (see Peak-Day Drinking Water Demands Trend).

Regulations

There are no regulations to report for meter equivalents.

Technology and Research

There are no updates in technology to report for meter equivalents.

Energy Management

There is no energy use to report for meter equivalents.

Strategic Plan Elements

Understanding how growth is occurring in our service area allows us to plan for our water supply needs and treatment and conveyance capacity needs (as well as our wastewater collection and treatment capacity needs). These are related to Strategic Initiatives 1 (provide reliable and high quality supply of water for next 50 years) and 3 (adopt budget decision processes to ensure affordable services).

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to monitor growth in service area by tracking new meter equivalents.	Monthly (for Dashboard report)		X

Drinking Water and Reclaimed Water Sales

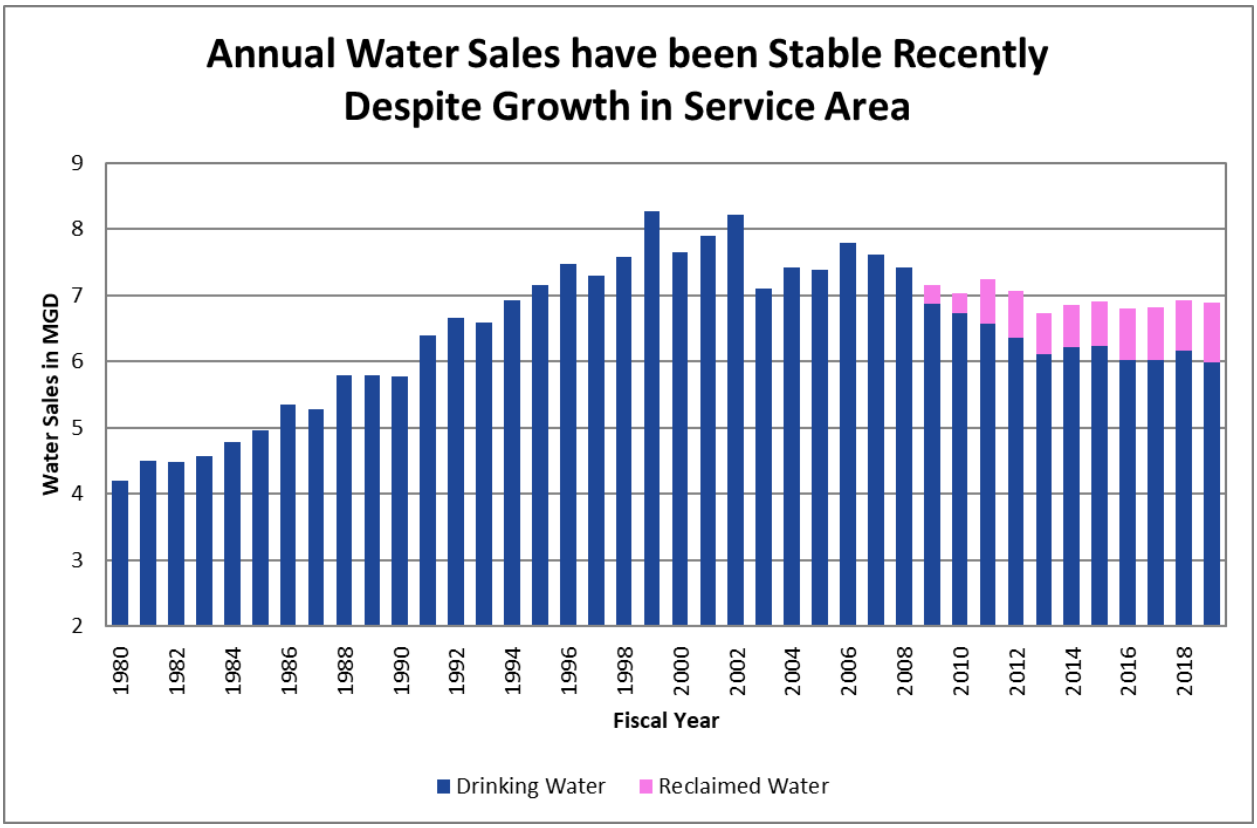


Figure 10. Annual Water Sales

Description: This trend evaluates average-day sales of drinking water and reclaimed water (in mgd) since 1980. (The reclaimed water system began operating in March 2009.)

Key Observations:

- OWASA's annual average drinking water sales have declined despite growth in the service area as shown in the Meter Equivalents trend. Drinking water sales are currently at about the same level they were 30 years ago.
- Total annual water sales (including reclaimed water) are 17 percent less from when they peaked in FY 1999, despite a 31 percent increase in customer accounts during that same time period. Drinking water sales declined 28 percent over that same period.
- Reclaimed water sales met over 11 percent of the community's water needs in FY 2019.

Regulations

There are no regulations to report for drinking water sales. For regulations on reclaimed water, see Reclaimed Water section.

Technology and Research

In accordance with Strategic Initiative 5, OWASA installed advanced metering infrastructure (AMI) with early leak detection. Since May 1, 2019, the Agua Vista Web Portal has provided alerts of over 4,000 potential leaks. Of those notifications, customers have confirmed leaks in 460 instances. In these cases, leaks were repaired within about a week of starting. The average leak was 69 gallons per hour. If allowed to continue for 35 days until a customer received a bill, each one of these leaks would have wasted tens of thousands of gallons. If these trends continue, the early leak notification services provided by AMI will help avoid a measurable, but modest amount of wasted water use.

Energy Management

Energy used to pump drinking water is shown in the Peak-Day Drinking Water Demands section.

Strategic Plan Elements

The Water Conservation Plan or demand management strategies evaluated in the update to the LRWSP (Strategic Initiative 1) may result in reduced drinking water sales. This in turn would impact revenue, which would be addressed through the financial management policies included in Strategic Initiative 3. Financial reserves help OWASA meet its financial obligations during times of reduced water sales such as may occur during drought conditions.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to identify cost-effective opportunities to expand the reclaimed water system which will help reduce our community's risk to drought, extend the capacity of the WTP, and optimize the use of our locally-controlled water supplies.	As opportunities arise; also evaluating some options as part of LRWSP update (early CY 2020)	X (as part of LRWSP update)	
2. Continue to identify cost-effective and customer-accepted opportunities for additional conservation.	Ongoing	X (as part of LRWSP update)	
3. Continue to monitor potential growth in our service area by working closely with Carrboro, Chapel Hill, and UNC to ensure we have adequate water treatment capacity for the future.	Annual with ongoing communication		X

Average Monthly Water Use and Billed Amount

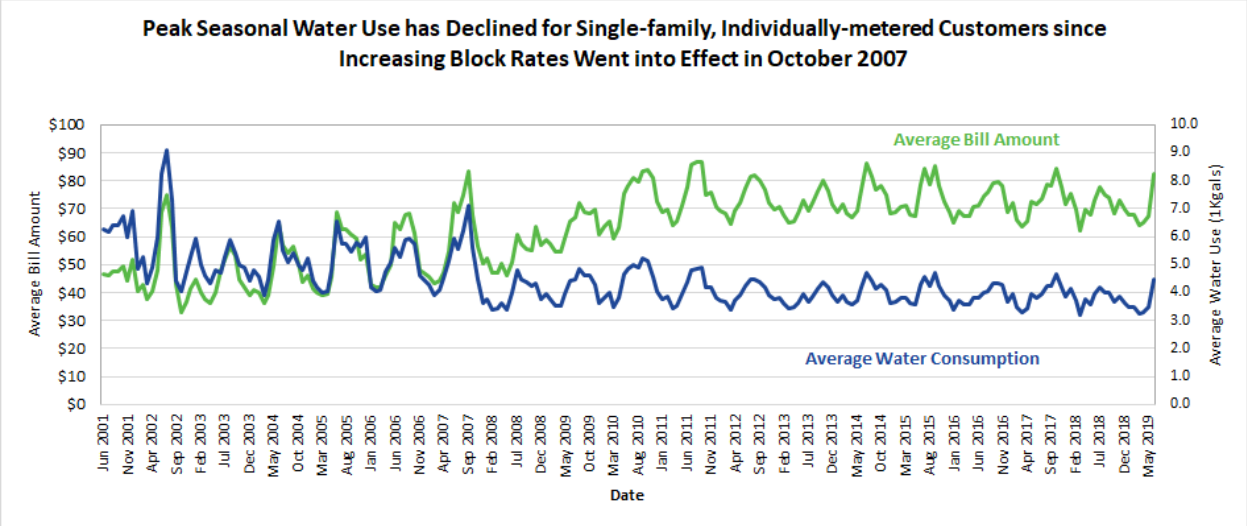


Figure 11. Single Family Residential Water Use

Description: This trend evaluates average monthly water use and the average monthly water and sewer charges for single-family, individually-metered residential customers.

Key Observations:

- Peak seasonal water use by this group of customers has declined, particularly after OWASA's increasing block rates went into effect in October 2007. This indicates that outdoor water use for single-family, individually-metered residential customers has diminished and implies a relationship with the change in our water rate structure.

Regulations

There are no regulations to report for water use.

Technology and Research

In accordance with Strategic Initiative 5, OWASA installed advanced metering infrastructure (AMI) throughout our service area. AMI allows OWASA and our customers to detect leaks earlier and is likely to have a measurable, but modest impact on overall system demand.

Energy Management

Energy used to pump drinking water is shown in the Peak-Day Drinking Water Demands section.

Strategic Plan Elements

The Water Conservation Plan and demand management strategies evaluated as part of the LRWSP (Strategic Initiative 1) may result in reduced drinking water sales. This in turn would impact revenue, which would be addressed through the financial management policies included in Strategic Initiative 3. Financial reserves help OWASA meet its obligations during times of reduced water sales such as may occur during drought conditions.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to track this trend to determine whether water use is increasing.	Annual		X

Physical Interconnection Capacity and Average Annual WTP Demands

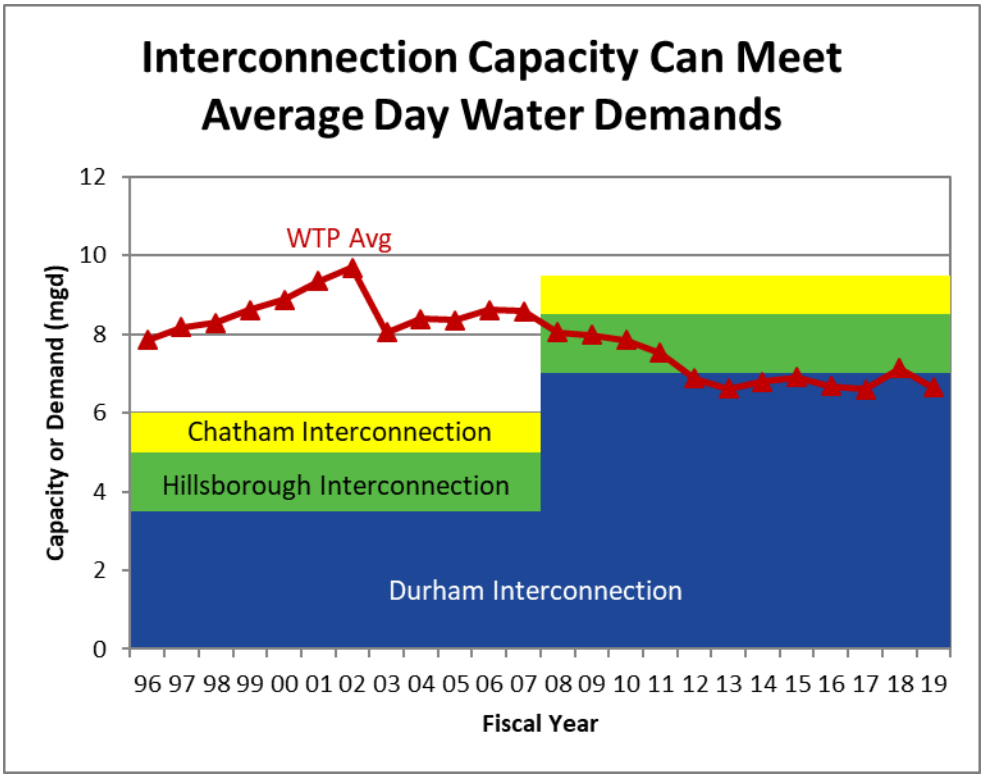


Figure 12. OWASA's Interconnection Capacity

Description: This trend evaluates the ability of OWASA's drinking water system interconnections with neighboring communities to meet average-day drinking water demands during planned or unplanned events that could affect our ability to treat and deliver water to our customers.

Key Observations:

- OWASA's existing physical interconnections are of sufficient capacity to meet average-day drinking water demands.
- Our drinking water system interconnections with the City of Durham have a combined capacity of about 7 mgd.
- We can receive about 1.5 mgd through our interconnection with the Town of Hillsborough, which was confirmed during recent testing.
- OWASA also has an interconnection with Chatham County. OWASA can receive approximately 1 mgd through this connection based on modeling analyses; during the November 2018 water emergency we received approximately 1.3 mgd from Chatham County.

- The combined capacity of our interconnections is about 9.5 mgd, which is about 143 percent of our FY 2019 average-day drinking water demands and about 126 percent of our FY 2019 water demands including reclaimed water.

Regulations

There are no regulations to report for interconnections.

Technology and Research

There are no updates in technology to report for interconnections.

Energy Management

Energy used to pump water at our interconnections is negligible under most conditions; however, it would increase considerably if, when, and in what amounts we are obtaining drinking water from a neighboring utility. In 2018, we provided 375 million gallons of water to Durham which flowed by gravity into their system. If that water had been returned, it would have had to be pumped into our system from Durham's distribution system.

Strategic Plan Elements

While Strategic Initiative 1 does not directly include operational emergencies, our interconnections help us meet our water supply needs for short periods if something happened to our raw water supply, treatment plant or distribution system.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. OWASA should continue to monitor this trend to ensure that average-day drinking water demands could be met through water system interconnections with our neighboring utilities.	Annual		X
2. Re-evaluate the capacity of system interconnections to ensure changes in system facilities and demands have not adversely affected our ability to import an adequate supply of drinking water to meet average-day demands during an emergency.	Periodically as needed		X
3. Perform field tests on all interconnections to ensure proper operation, train staff, and confirm capacity.	Routinely, in coordination with utility neighbors		X
4. Continue to work with Triangle Water Supply Partnership to use regional interconnections model for planning purposes to improve regional reliability and resiliency.	Ongoing		X

Drinking Water Distribution System Integrity

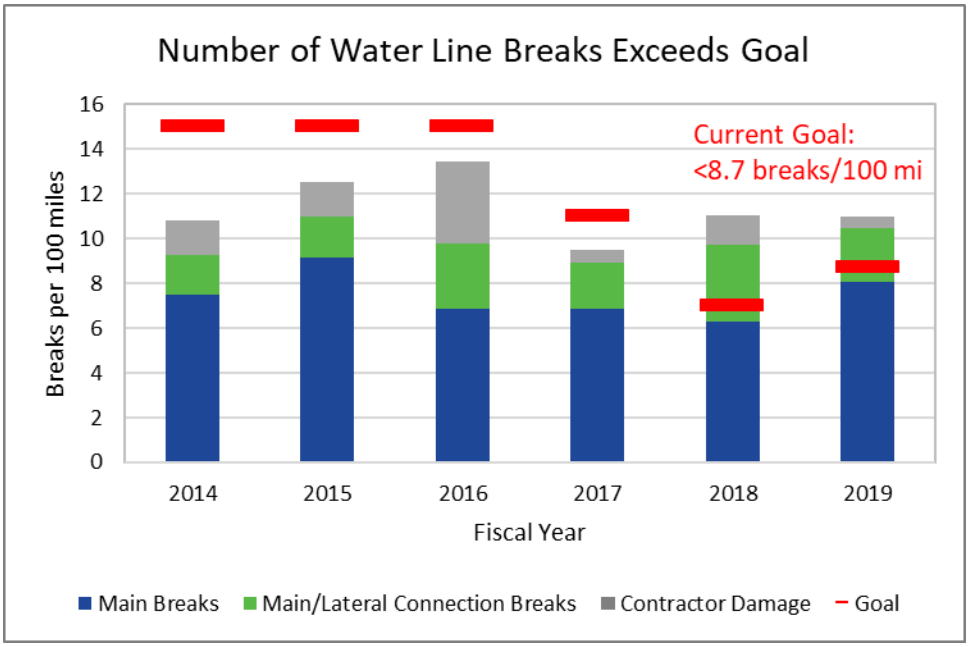


Figure 13. Historic Water Line Breaks

Description: This trend evaluates the number of water main breaks per 100 miles of water mains and connections with service lateral lines. These are important indicators of the integrity of our drinking water distribution system. It also includes information on lines damaged by contractors; while that metric does not impact the integrity of our water distribution system, there is an impact on our customers and thus we include contractor damage in this trend.

Key Observations:

- We have had more water main breaks than our goal of 8.7 main breaks or less per 100 miles of pipeline, which is based on median of value included in the most recent American Water Works Association (2019) Benchmarking report. (Note: In prior reports we used goals of 11, 15, and 7 main breaks or less per 100 miles of pipeline based on earlier Benchmarking reports).
- OWASA experienced a water main break outside its Jones Ferry Road WTP on November 5, 2018 resulting in a system-wide do not use advisory. To improve the reliability and resiliency of our water system, OWASA is undertaking a major update of our risk-based water main prioritization model; collaborating with UNC, UNC Hospitals and other key stakeholders on resiliency solutions; inspecting all valves; and investing in rehabilitation and replacement projects through the capital improvements program.

Regulations

Federal and State testing requirements require public water systems such as OWASA to test for lead in drinking water collected from customers' homes as part of the Lead and Copper Rule. Samples must be collected from homes that meet criteria set by the EPA; these criteria identify "high priority" homes that are most likely to have elevated lead levels. OWASA tests for lead in drinking water in 30 homes built from 1983 to 1985 that have copper pipes with lead solder every three years. In the previous four rounds of monitoring, we have had only one sample with a measurable level of lead and the result was below the regulatory limit. The most recent round of monitoring for lead and copper in the distribution system was completed September 30, 2017; only one sample had a measurable level of lead and the result was below the regulatory limit. The EPA will be publishing new draft lead and copper rules in the federal register shortly; staff is monitoring the proposed changes to ensure we will meet any new requirements. OWASA also provides testing of our drinking water for lead at no charge when requested by a customer.

Technology and Research

Technologies exist to assess the condition of pipe, monitor system pressure and detect leaks. The ongoing Water Main Prioritization Study, in conjunction with the update of the risk framework for distribution system pipes, will evaluate the applicability of currently available technology and will develop a programmatic strategy for the optimal use of condition assessment technologies and procedures, system monitoring, and leak detection to help refine our understanding of system integrity and ultimately inform investment decisions about pipe replacement and other actions.

Due to the cost and complexity of performing assessments on in-service pressurized pipes, water main condition assessment is typically focused on pipes identified as high risk by a prioritization model. However, OWASA's options are limited due to the prevalence of asbestos cement (AC) pipe, which does not lend itself to non-destructive condition assessment technologies. The condition of AC pipe can only be assessed by removing sections of pipe and having those analyzed. Done as a standalone activity, this assessment process can be very costly, can disrupt service to customers, and runs the risk of degrading the integrity of the pipe. Therefore, we will likely be implementing an opportunistic condition assessment program that will capitalize on events where our pipes are exposed during construction activities or when repairing breaks and leaks. Pipe samples, soil samples, and corrosion potential measurements will be taken during these events and will inform a database of information staff can use to assess the general condition of adjacent pipes.

For metallic pipes, insertion of a camera is the simplest method; however, the resulting assessment is qualitative (i.e. good, fair, poor). Typically, a visual inspection does not provide sufficient information on pipe condition because it does not provide information on the strength of the pipe or on external conditions which may lead to pipe failure (e.g. external corrosion, bedding condition, or utility crossings). This method of assessment tends to cost more per linear foot and has a lower accuracy than other assessment methods.

Detecting leaks can help identify conditions that may cause breaks; however, not every leak will cause a break (i.e. complete structural failure) and not every break is caused by a leak. Furthermore, water loss is not a significant issue in our system, so identifying and repairing leaks will not appreciably reduce unaccounted for water. Leak detection tends to have a moderate cost and accuracy, relative to other technologies.

Energy Management

As reported in the Peak-Day Drinking Water Demands section, over half of the energy used at the WTP is actually for pumping drinking water into the distribution system and for maintaining system storage levels to maintain pressure and meet peak demands. In addition, we use energy to pump finished drinking water into a higher pressure zone. Combined, these two uses of energy account for approximately 13% (2.2 million kWh) of the energy we used in 2018. Other energy is fuel for vehicles and equipment used to maintain our drinking water distribution system.

Strategic Plan Elements

Strategic Initiative 3 includes a goal to make the right investments at the right time, and to base this information on our asset management program. Maintaining and replacing our infrastructure when needed enables us to maintain high levels of service to our customers over the long-term.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Use OWASA's water main prioritization model and risk framework to inform investment decisions for the condition assessment and rehabilitation of the drinking water distribution system.	Annual		X
2. Continue the programmatic replacement of aging galvanized water mains throughout the distribution system.	Through FY 2024		X
3. Update the prioritization model's risk framework to account for current data sources and statistical trends in main break history.	Through FY 2020		X
4. OWASA inspected all critical and previously uninspected valves in CY 2019. Staff has a goal of inspecting all valves every four years and inspecting all critical valves annually.	Ongoing		X
5. Continue to fund our water main renewal/replacement program to ensure system sustainability.	Annual	X	
6. Develop risk mitigation and emergency response procedures with key customers such as UNC, UNC Hospitals for water supply resiliency.	Ongoing		X
7. Maintain Presidents Award status by the Partnership for Safe Water (see chapter on "OWASA's Planning Environment") for Distribution System Operation.	Ongoing		X

Water System Audit

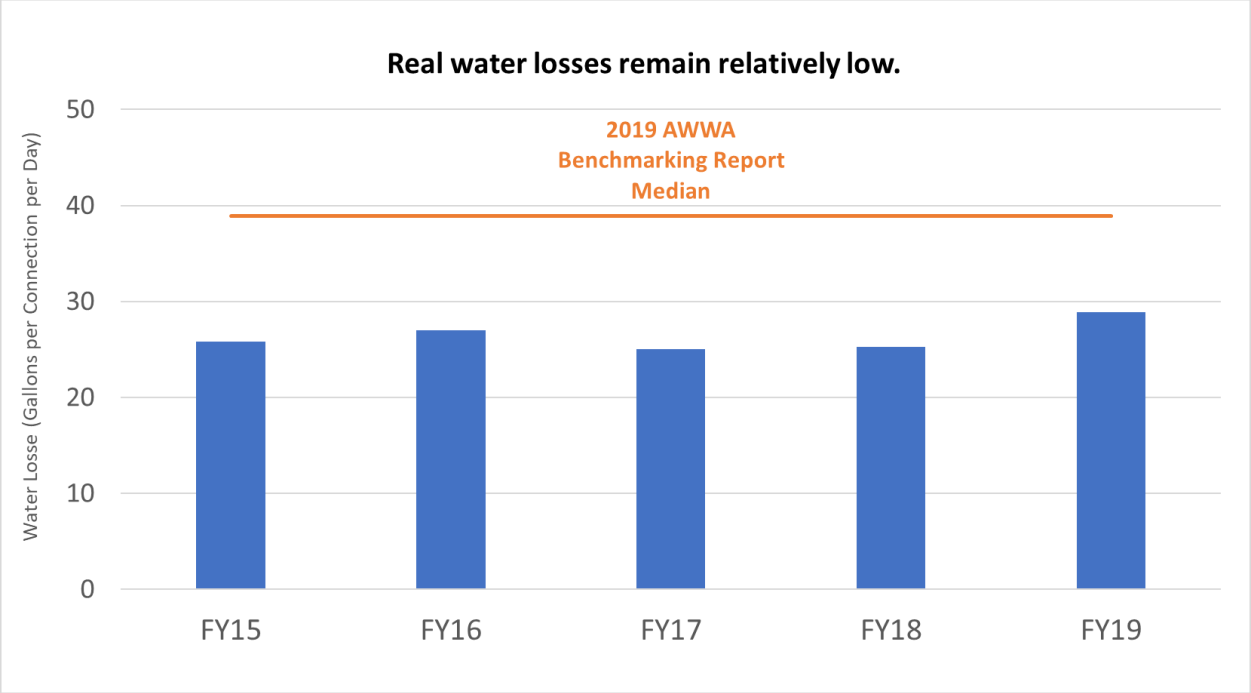


Figure 14. Historic Real Water Loss

Description: This trend evaluates the annual volume of water lost through leaks in the distribution system. Real loss is the difference between water supplied and authorized consumption; utilities also subtract out apparent losses associated with inaccuracies in metering, data errors, and estimated water theft.

Key Observations:

- Although OWASA experienced a moderate increase in real water loss last year, our water loss remains less than other utilities. In years past, the median water loss for water utilities in Georgia (a state where all water providers that serve a population of 3,300 or more conduct annual, validated water system audits) was about 40 gallons per connection per day. The median water loss reported in this year's AWWA Benchmarking survey was 38.87 gallons per connection.

Regulations

There are no regulations to report for real water loss.

Technology and Research

The Drinking Water Distribution System Integrity trend includes information on acoustic leak detection.

Energy Management

Energy used to pump drinking water is shown in the Peak-Day Drinking Water Demands section.

Strategic Plan Elements

Strategic Initiative 1 includes the development of a Water Conservation Plan, an important element of our updated Long-Range Water Supply Plan. Strategic Initiative 3 includes a goal to make the right investments at the right time, and to base this information on our asset management program. Understanding the amount of water loss in our system helps make investment decisions. Maintaining and replacing our infrastructure when needed enables us to maintain high levels of service to our customers over the long-term.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Update water audit information	Annual		X

Wastewater Collection System Integrity

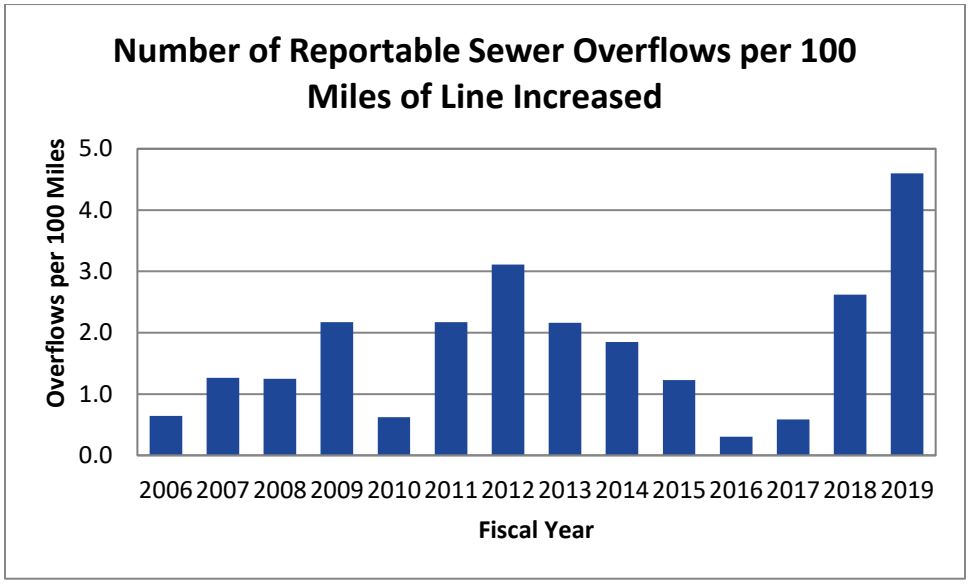


Figure 15. Historic Reportable Sanitary Sewer Overflows

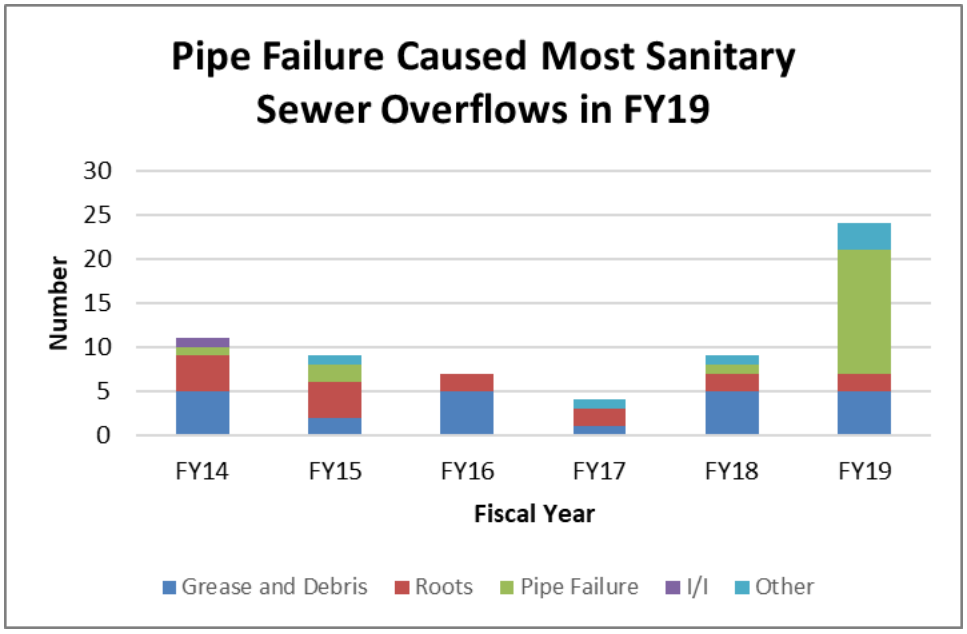


Figure 16. Historic Causes of All Sanitary Sewer Overflows

Description: This trend evaluates the number of reportable sewer overflows, which is an important indicator of the integrity of our wastewater collection system. It also evaluates the causes of all sewer overflows.

Key Observations:

- On April 12, 2019, the Rogerson Drive Force Main which collects wastewater from a large portion of OWASA's service area broke near Raleigh Road during a heavy rain event. Several sanitary sewer overflows occurred as a result of the break over the next 36 hours. OWASA immediately began emergency repair activities, installed a temporary bypass to convey flow across Raleigh Road, constructed new pipe that resists corrosion, and built a parallel line under Raleigh Road that can be used as a bypass in case it is needed in the future.
- The number of overflows increased in FY 2019, but it should be noted that the Rogerson Drive pipe failure accounted for 14 of a total of 16 reportable sanitary sewer overflows. These overflows occurred as a result of our need to limit the pumping capacity at the station to manage the leak and address the failure in the force main. If we consolidate these overflows into a singular event, there would have been 0.86 breaks per 100 miles in FY 2019.
- The number of reportable overflows is more than 1.9 per 100 miles of pipeline, which is the national median per the American Water Works Association 2019 Benchmarking report. The 25th percentile in that report was 3.2 overflows per 100 miles of pipeline. Per DEQ guidance, OWASA strives to have no overflows. (Note: We used the median value of 2.7 per 100 miles of pipeline from the 2012 Benchmarking report in 2016 and prior Strategic Trends reports).
- In FY 2019, pipe failure was the primary cause of overflows, but this is due to the Rogerson Drive force main break. Typically, grease, debris, and roots are the primary causes of overflows; if you only counted one overflow for Rogerson Drive, the primary cause in FY 2019 would have been grease and debris. Reducing grease will require proactive, recurring education of our customers – especially those in the food service sector. Customers can also help minimize potential root intrusion by not planting trees near our sewer lines.

Regulations

There are no upcoming regulations to report for our wastewater collection system.

Technology and Research

- Advanced, automated flow measurement technologies are available for real-time monitoring of wastewater collection systems. These flow monitors may be connected to our SCADA system. When monitors indicate that water levels inside a pipe increase, it may be an indication that the line is blocked downstream or there is substantial inflow and infiltration (I&I) during rain events. Recent work with consultants on our hydraulic model has indicated that a permanent flow monitoring system may have merit in identifying areas susceptible to I&I. We intend to more thoroughly investigate the feasibility of such a system in the near future.
- Acoustic monitoring to detect sewer line blockages is available. A device sends a sound down a line to help find obstructions. A pilot test of this type of technology indicated that it was not yet reliable and cost-effective.

- Robotic Pipeline Monitoring and Maintenance Systems which can complete robotic inspections of pipelines are also being developed. This method is still in its early stages and still not cost effective to deploy throughout the collection system. Historically, this technique has been used by other utilities to assess the wastewater constituents rather than the pipeline condition.

Energy Management

Wastewater is primarily conveyed through the force of gravity; however, wastewater pumping stations are necessary to transport wastewater when gravity flow is not possible. All of our wastewater pumping stations are powered by electricity, with diesel fuel or natural gas being used to power emergency standby generators when electrical service is unavailable. Electricity use by OWASA's wastewater pumping stations has been relatively consistent over the last six years, with the Rogerson Drive Pump Station accounting for about 65 to 70 percent of the electricity used for collection system pumping.

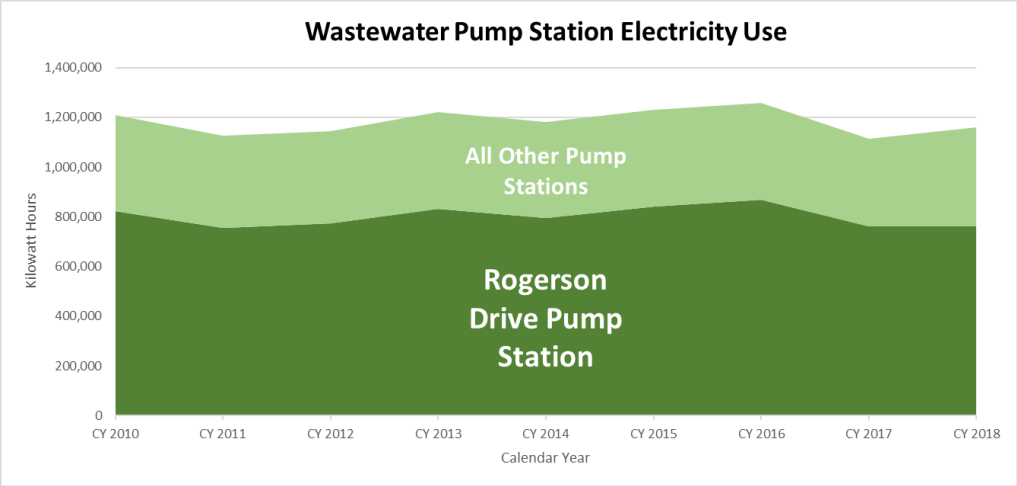


Figure 17. Wastewater Pump Station Electricity Use

Strategic Plan Elements

Strategic Initiative 3 includes a goal to make the right investments at the right time, and to base this information on our asset management program. Maintaining and replacing our infrastructure when needed helps us meet the community's wastewater needs.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to use the findings and recommendations from the 2011 Sewer System Master Plan and subsequent Sewer Evaluation Reports as a guide for prioritizing funding for sewer system evaluation, rehabilitation and replacement. Update the Master Plan's modeling efforts periodically as flow demand patterns change. The goal of these actions is to reduce inflow and infiltration.	Ongoing		X
2. Integrate the results of the sewer system modeling and field condition assessment work into the comprehensive asset management program so that the trade-offs of different capital improvements investment decisions can be consistently evaluated and prioritized.	Annual		X
3. Investigate the feasibility of installing flow monitoring equipment in the collection system to identify areas susceptible to I&I.	TBD depending on other priorities		X
4. Continue to inspect, clean, and rehabilitate our sewer lines and wastewater pumping stations as needed to prevent overflows, reduce infiltration and inflow, and ensure adequate capacity.	Ongoing		X
5. Continue to monitor and maintain sewer easements to ensure our equipment and personnel can access the sewer system for maintenance and repair work, and to ensure tree root intrusion into sewers is minimized and corrected.	Ongoing		X
6. Continue to educate the public on the importance of not pouring fats, oils and grease, medications, etc. down the drain and not flushing items other than toilet paper.	Ongoing		X
7. Continue to fund the sewer system renewal/replacement program and operations and maintenance activities to ensure system sustainability.	Annual	X	
8. Identify potential energy savings opportunities for wastewater collection in Energy Management Program	Ongoing	X (as part of Energy Mgmt Plan)	

Mason Farm Wastewater Treatment Plant Maximum Month Flows

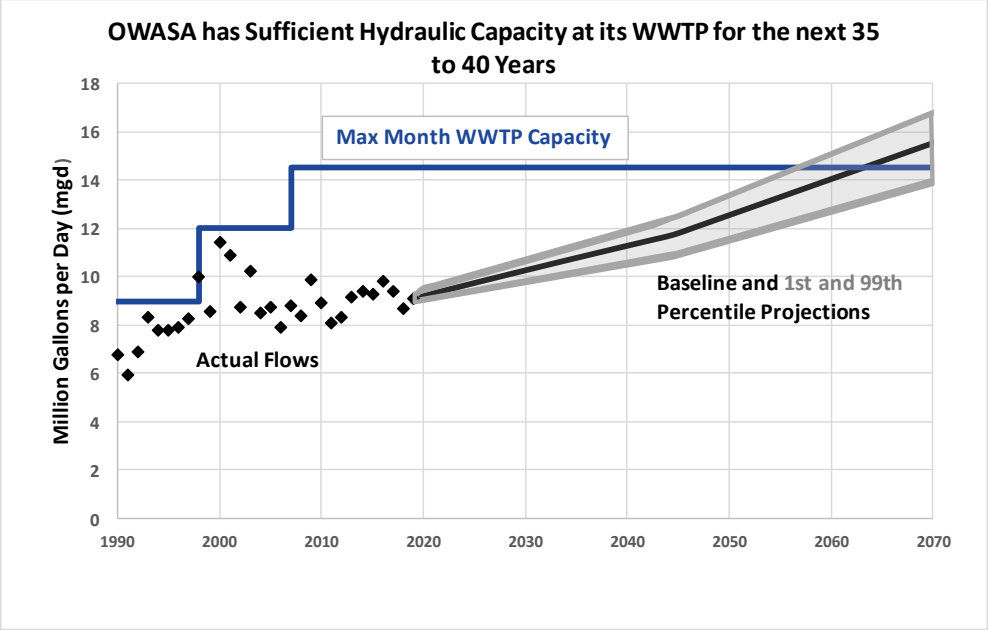


Figure 18. Mason Farm WWTP Capacity and Demands

Description: The Mason Farm Wastewater Treatment Plant (WWTP) has a permitted capacity of 14.5 mgd, which is the maximum average daily flow which can be treated in any given month. This trend tracks historical annual maximum month of flow and compares those against the permitted capacity of the WWTP.

Key Observations:

- OWASA's maximum month wastewater flows have declined from a peak of 11.5 mgd in FY 2000. This corresponds to reduced drinking water demands by our customers, as well as our continuing investments in the rehabilitation and replacement of sewer lines and manholes.
- In FY 2019, the maximum month flow was 9.1 mgd, which is about 63 percent of the WWTP's permitted flow capacity.
- The projected maximum month flows indicate that we have adequate hydraulic capacity in our treatment plant for the next 35 to 40 years assuming inflow and infiltration rates do not increase.

Regulations

- Important regulations pertaining to wastewater treatment are related to nutrient removal at the WWTP, which is described in the Mason Farm WWTP Nutrient Capacity section of this report.

- As mention previously in this report, PFAS are emerging compounds of concern. Drinking water and wastewater are not sources of PFAS. PFAS are present throughout the environment because they are highly persistent and have been widely used for decades, including in industrial applications, household and consumer products, food packaging, and firefighting foams. The North Carolina Division of Water Resources (DWR) is implementing several projects associated with emerging compounds. Studies were done in 2018 to characterize the presence of these compounds in various water supply reservoirs. The results from these studies indicated that the Cape Fear River Basin was of concern in the occurrence of these emerging compounds. An effort is underway to develop an overall management strategy to reduce the levels of these compounds in the Cape Fear River Basin. As part of this strategy, DWR is requiring utilities in the Cape Fear River Basin with significant industrial dischargers to begin investigative monitoring of their wastewater influent for PFAS. Depending on those results, utilities may be required to perform further monitoring to identify the potential sources of PFAS in their system. Once these sources are identified, the utility would be required to work with the dischargers to reduce/eliminate the PFAS compounds. While OWASA does not have any significant industrial dischargers, therefore not required to participate, we do believe it is important for us to know what is in our wastewater. OWASA completed initial investigative monitoring of our wastewater influent for PFAS throughout the Summer of 2019. These results are being evaluated and next steps are under development.

Technology and Research

- Staff is beginning a CIP project to replace our gravity belt thickeners with rotary drum thickeners which thicken solids prior to anaerobic digestion. The rotary drum thickeners have two advantages: (1) better odor control which also extends the life of equipment in the solids thickening building and (2) better control of the solids concentration and reduced operating costs.
- Staff has completed implementation of a new Supervisory Control and Data Acquisition (SCADA) system with "high performance SCADA system design". The high performance SCADA system simplifies the graphics on-screen to improve operators' situational awareness of plant operations. It also enables the operators to look at and evaluate data in real time for a wide variety of plant information from the operators' terminals without requiring any specialized programming, database management or outside assistance.
- Staff at the WWTP periodically evaluate the chemicals used at the plant to ensure we are using the best available in terms of meeting our treatment goals in the most sustainable manner as well as to ensure that we do not foresee shortages in chemicals we use which could impact treatment or their price. At this time, staff believe we are using the correct blend of chemicals and no shortages are foreseen in their supply.
- Staff is closely following advancements in technology and actual industry experience for resource recovery at the WWTP. This includes energy generation such as the biogas to energy alternatives being evaluated as part of the Energy Management Program, nutrient recovery for beneficial reuse, and direct and indirect potable reuse. Biogas recovery strategies are being evaluated as part of the

Energy Management Plan, and opportunities for greater reuse will be evaluated as part of the Long-Range Water Supply Plan.

Energy Management

The Mason Farm WWTP is our largest energy-using facility. Since 2010, our electricity use at the WWTP has decreased by about 38 percent. This is largely attributable to a $10.4 million capital improvement project that reduced electricity use, further reduced off-site odor releases, improved plant performance, and prepared us to meet future standards for treated wastewater quality. In 2018, our use of natural gas declined significantly because we restored our biogas-to-boiler system. Primarily natural gas is used mostly as a supplemental fuel for running the two boilers that heat anaerobic digesters for solids treatment. Methane – or biogas – is produced as a by-product of the digestion process, and under normal operations, is used as the primary fuel in our boilers at the plant. However, from 2015 through March 2018, we had to rely almost exclusively on natural gas to heat the boilers while two digesters and our gas storage unit were undergoing major rehabilitation. In restoring the biogas-to-boiler system in March 2018, we reduced our natural gas use at the WWTP by about 70,000 therms.

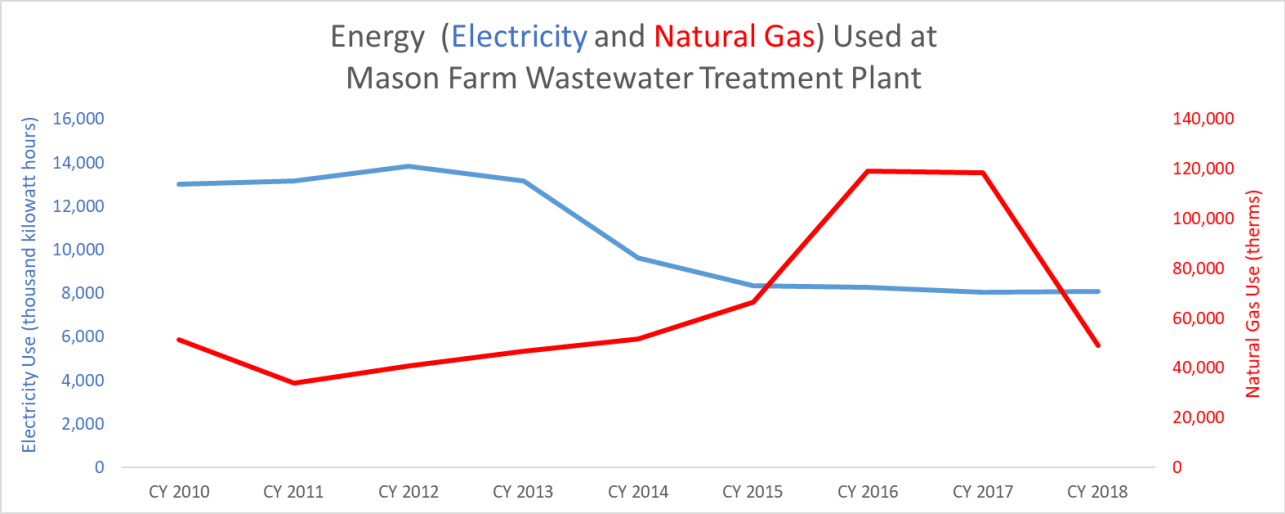


Figure 19. Energy Use at the Mason Farm WWTP

Strategic Plan Elements

Strategic Initiative 3 includes a goal to make the right investments at the right time, and to base this information on our asset management program. Ensuring that our wastewater treatment capacity is adequate, and timing expansions properly, helps us meet the community's wastewater needs.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to monitor growth and development activity and projections in our service area by working closely with the Towns of Carrboro, Chapel Hill, and UNC to ensure we have adequate wastewater treatment capacity for the future.	Annually with ongoing communication		X
2. Continue to inspect, rehabilitate, and replace our sewer lines when necessary to reduce infiltration and inflow.	Ongoing		X
3. Identify potential energy savings opportunities for wastewater treatment and pumping in Energy Management Program.	Ongoing	X (as part of Energy Mgmt Plan)	
4. Complete Partnership for Clean Water (see chapter on "OWASA's Planning Environment") Phase III self-assessment process pursuant to Directors Award status for Excellence in Wastewater Treatment.	Ongoing		X

Mason Farm WWTP Nutrient Capacity

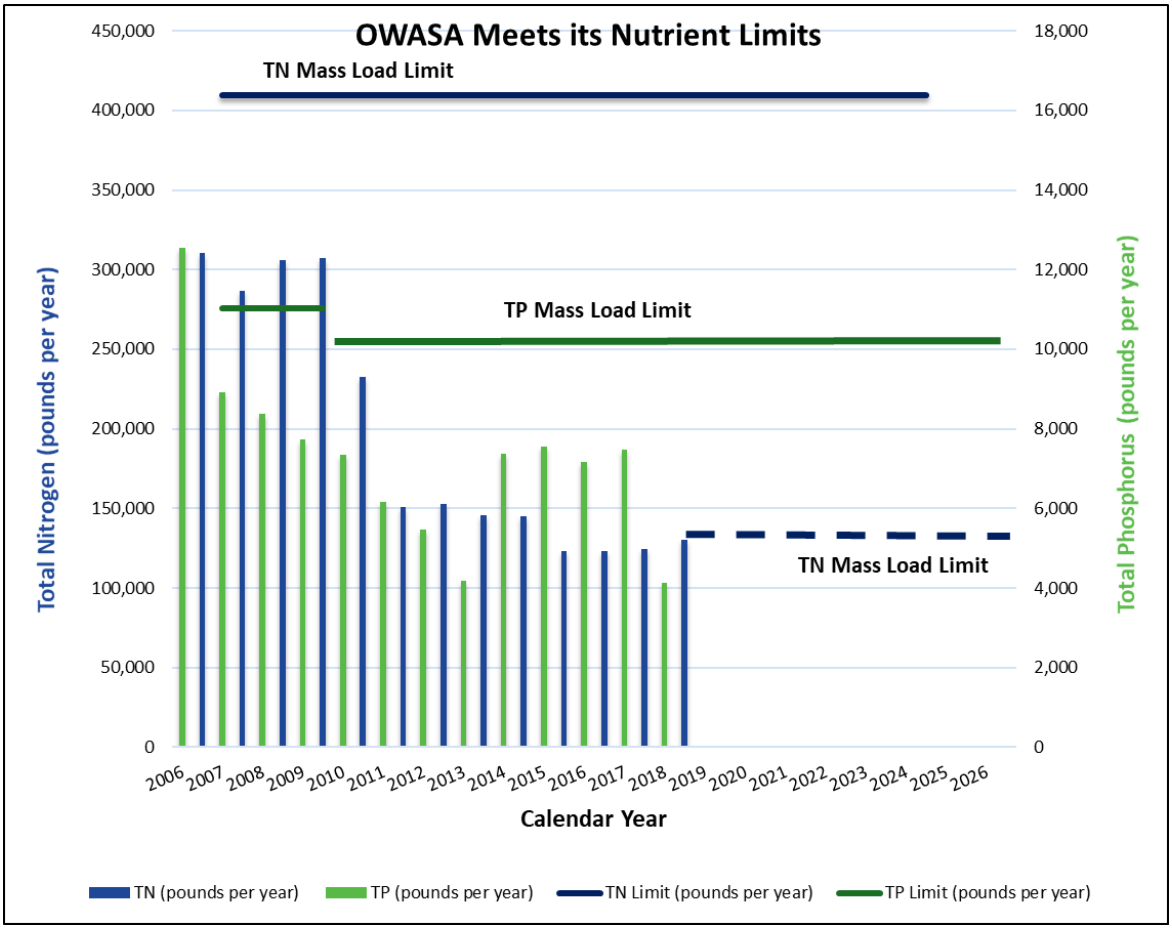


Figure 20. Mason Farm WWTP Annual Nutrient Loading

Description: The State's Jordan Lake nutrient management rules require point sources to reduce their discharge of Total Phosphorus (TP) and Total Nitrogen (TN). OWASA has interpreted legislation along with feedback from DEQ that the new TN limit would apply in 2024. DEQ recently informed us that it will apply in 2019. OWASA is in communication with DEQ regarding the TN requirement, and the new TN mass load limit is shown as a dashed line in the figure to reflect the uncertainty in the permit date. We report nutrient loading on a calendar year basis rather than a fiscal year basis since our permit limits for TN and TP are on a calendar year.

Key Observations:

- OWASA has met its TP limit since the annual mass load limit was first incorporated into our permit in 2007. We expect to continue to meet the limit within the 20-year planning horizon without the need for additional major capital improvements for TP removal.

- OWASA better optimized its biological phosphorus removal process which is reflected in the decrease in TP in 2018.
- OWASA has consistently met its current TN limit, but we will have to operate our filters in denitrification mode and incur considerably greater energy and chemical costs to meet the more stringent limits whenever those go into effect. Installation of sidestream treatment facilities may reduce operating costs and energy use for TN compliance and have a positive payback compared to relying primarily on the denitrification in the filters at the WWTP.

Regulations

The NC General Assembly enacted legislation (House Bill 97) that defers the effective date for implementation of more stringent TN mass load limits for WWTPs in the Jordan Lake watershed to 2021 or 2024. We recently received a letter from DEQ that indicated that the nitrogen limit would apply in 2019. OWASA is in communication with DEQ regarding the permit compliance date. As part of OWASA's participation in the Partnership for Clean Water, OWASA will be trying to meet 95 percent of the nutrient limits that will be in effect. Staff will continue to closely follow Jordan Lake nutrient issues, and we will inform the Board if any changes are needed in the timing or scope of major anticipated capital or operational improvements required to ensure compliance with the new limit.

Technology and Research

- OWASA evaluates the treatment technologies we have at our WWTP to ensure we can meet upcoming standards with current treatment technologies. OWASA can meet all applicable permit limits, but we will need to operate our filters in denitrification mode to remove nitrogen when revised limits become effective. (Based on 2015 action by the NC General Assembly, the new expected date for a much more stringent TN limit is 2024). Carbon must be added to achieve denitrification in the WWTP filters, and there are different operational, safety, financial, and environmental considerations associated with different carbon sources We will evaluate the advantages and disadvantages of alternative carbon sources, and conduct pilot and plant-scale testing as needed, to inform our decisions regarding the preferred source.
- Sidestream treatment for greater nutrient removal is a process that may be considered for the Mason Farm WWTP if we decide to dewater a greater portion of our biosolids. Sidestream treatment would help to reduce nitrogen loading in the liquid treatment process. Modeling studies indicate that if we dewater all of our biosolids, sidestream treatment could provide annual chemical and energy cost savings of approximately $200,000 and have a payback of less than ten years. Sidestream treatment could also provide additional process flexibility in meeting TN limits; it may also allow a rerating of the plant to a higher treatment capacity, thereby providing substantial cost savings for our customers. The City of Durham uses side stream treatment at one of its WWTPs.

Energy Management

See the section titled Mason Farm Wastewater Treatment Plant Maximum Month Flow Projections for energy use information at the WWTP. As noted above, certain advanced nutrient recovery technologies may have the potential to further reduce energy use for the liquid wastewater treatment process.

Strategic Plan Elements

Strategic Initiative 3 includes a goal to make the right investments at the right time, and to base this information on our asset management program. Ensuring that our wastewater treatment technology can meet permit requirements and incorporating changes in operations to meet limits helps us meet the community's wastewater needs.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Continue to monitor nutrient loadings at the plant.	Monthly		X
2. Continue to optimize denitrification performance in the aeration basins.	Ongoing		X
3. Evaluate ability of existing filters (and advantages and disadvantages of alternative carbon sources) to meet TN permit limits.	2019 - 2020		X
4. Evaluate benefits and costs of different nutrient removal strategies as part of Mason Farm WWTP Master Plan update.	FY 2022		X

Reclaimed Water

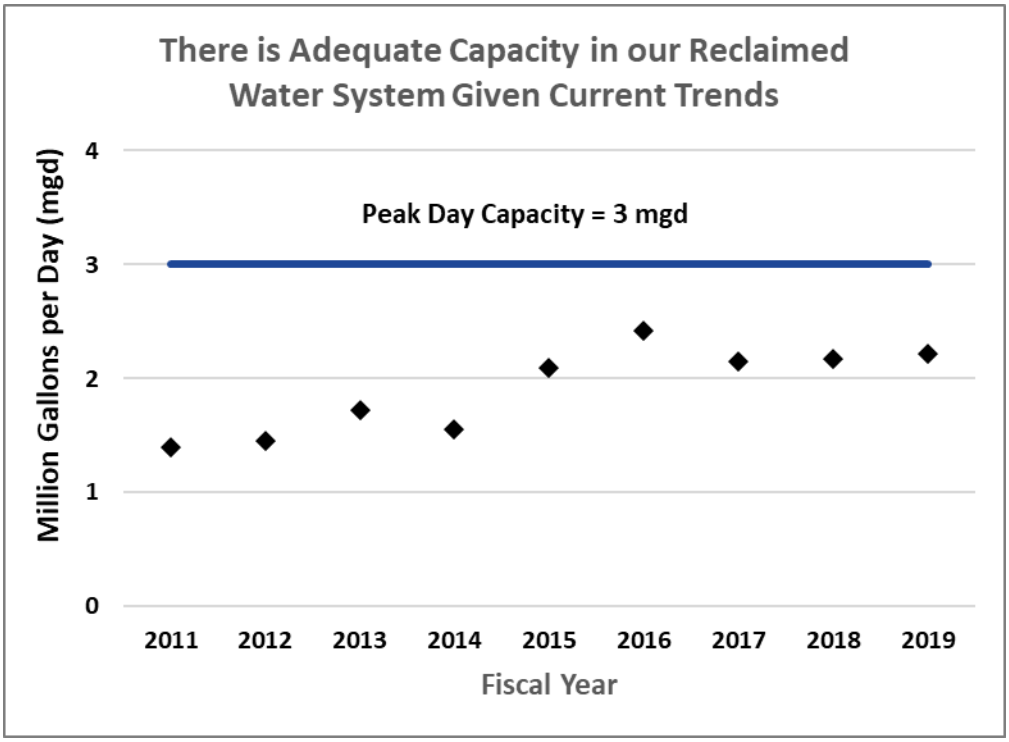


Figure 21. Reclaimed Water System Capacity and Demands

Description: This trend tracks historical annual peak-day reclaimed water (RCW) demands and compares those against the peak day capacity of the Mason Farm WWTP's RCW system.

Key Observations:

- The majority of RCW is used for chilled water and irrigation of landscaping and athletic fields and these demands peak during warm months (April-October). Demands are typically lower during cold months (November-March).
- Peak daily demand of 2.4 mgd occurred in August 2016 when it was very hot and humid. The RCW system is currently configured to meet a total peak day demand of 3 MGD (average daily demand of 1.2 MGD); however, the system is designed and constructed to allow cost-effective expansion to 5.2 MGD by adding only an additional transfer pump and additional chemical feed system capacity (if that feed system is deemed necessary).
- There is no anticipated significant change in demand for the next 15 years, and therefore the RCW system can meet projected RCW demand for the foreseeable future.

Regulations

In 2014, the NC General Assembly ratified Senate Bill 163 (Session Law 2014-113) to allow for indirect potable reuse, provided that a pretreatment mixing basin is created and used to mix raw source water

and reclaimed water, and that reclaimed water does not comprise more than 20 percent of the total combined supply. OWASA will evaluate the costs and benefits of this potential water supply source as one of the options considered during the update of our Long-Range Water Supply Plan. More information on RCW and reuse is provided in the Technology and Research section below.

Technology and Research

One aspect of reuse is recycling water within a building, which has been done in other parts of the country. One example (Solaire) is a high rise building in New York City which uses various filtration (membranes) and disinfection (ultraviolet light) technologies to produce reclaimed water that is beneficially recycled within the building and used for flushing toilets, cooling tower make-up water, and irrigating the green roof. The WaterHub at Emory University is an onsite wastewater reclamation system which uses ecological processes and stormwater capture to meet the campus's nonpotable water demands. A similar stormwater capture and treatment system is being planned for Chatham Park in Chatham County.

Energy Management

In February 2015, we began sub-metering and monitoring the energy uses of a few specific processes at the WWTP, including the RCW system. The RCW system is not just important for its impact on our use of raw water resources, but it is a more energy-efficient way to meet demands. The energy required to treat and deliver reclaimed water is about 20% less than that is required to treat and deliver raw water to the community. In 2018, on average, we used 2.37 kWh to treat and deliver 1,000 gallons of raw water; we used 1.84 kWh to treat and deliver 1,000 gallons of reclaimed water throughout the year.

Strategic Plan Elements

Strategic Initiative 3 includes a goal to make the right investments at the right time, and to base this information on our asset management program. Ensuring that our RCW system capacity is adequate will help meet the community's water needs. This also ties to Strategic Initiative 1; the use of RCW reduces the demand on our drinking water supplies which will help meet our community's long-term water supply needs. Finally, the use of RCW uses less energy than treating and delivering raw water, which ties to Energy Management Program in Strategic Initiative 4.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Verify RCW meters are properly calibrated and recording flows accurately.	Annual		X
2. Closely monitor RCW demands in order to ensure RCW system capacity expansion is planned, designed, and funded in time to meet future demands.	Ongoing		X
3. Pursue cost-effective opportunities to expand the RCW system to serve non-drinking water demands of non-UNC customers as new growth and development/redevelopment occurs.	Ongoing – evaluating some options as part of LRWSP update	X	
4. Work with UNC to identify actions to mitigate potential risk factors to the RCW system.	FY 2020		X

Biosolids

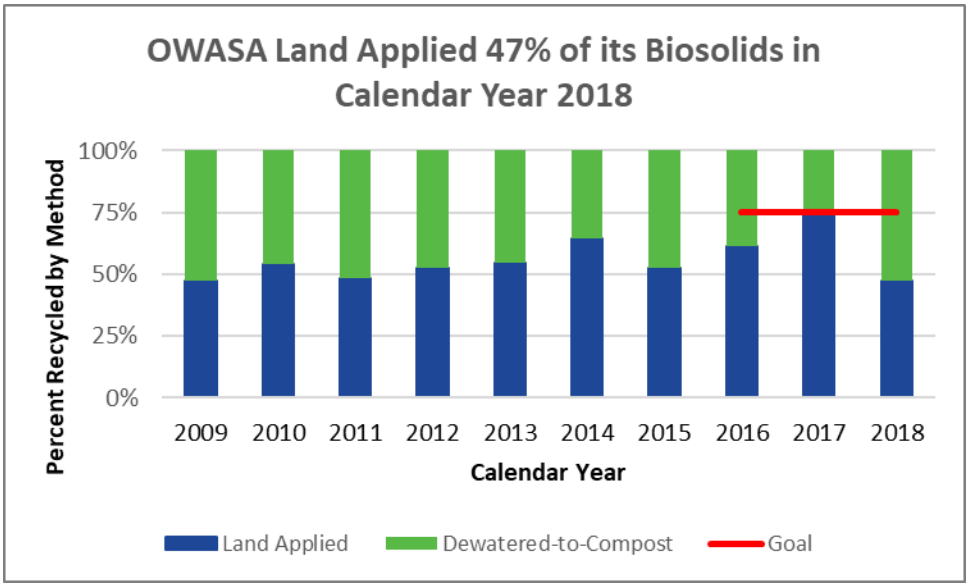


Figure 22. Historic Biosolids Application

Description: This trend evaluates the amount of biosolids which OWASA applies to land and the amount it dewaters for composting. The WWTP produces about four dry tons of biosolids each day. Most of this is applied in liquid form to agricultural land and a portion is dewatered to the texture and consistency of moist soil and transported to a private composting facility in Chatham County. For the liquid form, OWASA has 1,146 acres of farm land in Orange, Chatham and Alamance counties available for its Class A land application program (see Figure 23). 86 percent (992 acres) is privately owned. The remaining 154 acres are owned by OWASA as part of a 700-acre tract west of Orange Grove Road in Orange County. At its October 8, 2015 work session, the Board of Directors agreed that OWASA's goal is to apply 75 percent of our biosolids in liquid form, and to dewater 25 percent of our biosolids. The Board of Directors understands that there are factors including weather conditions which may keep staff from meeting the goal.

Key Observations:

- Prior to CY 2014, OWASA consistently land applied about half of its biosolids and dewatered and composted the remaining half.
- In CY 2018, OWASA land applied 47 percent of its biosolids and did not meet the goal. Our ability to meet this goal is dependent in part on weather and staffing. Our opportunities to land apply biosolids were limited in 2018 due to wet conditions and short-staffing which limited our ability to land apply. Instead, we dewatered higher amounts of biosolids while meeting all applicable regulatory requirements for our biosolids treatment and recycling program.

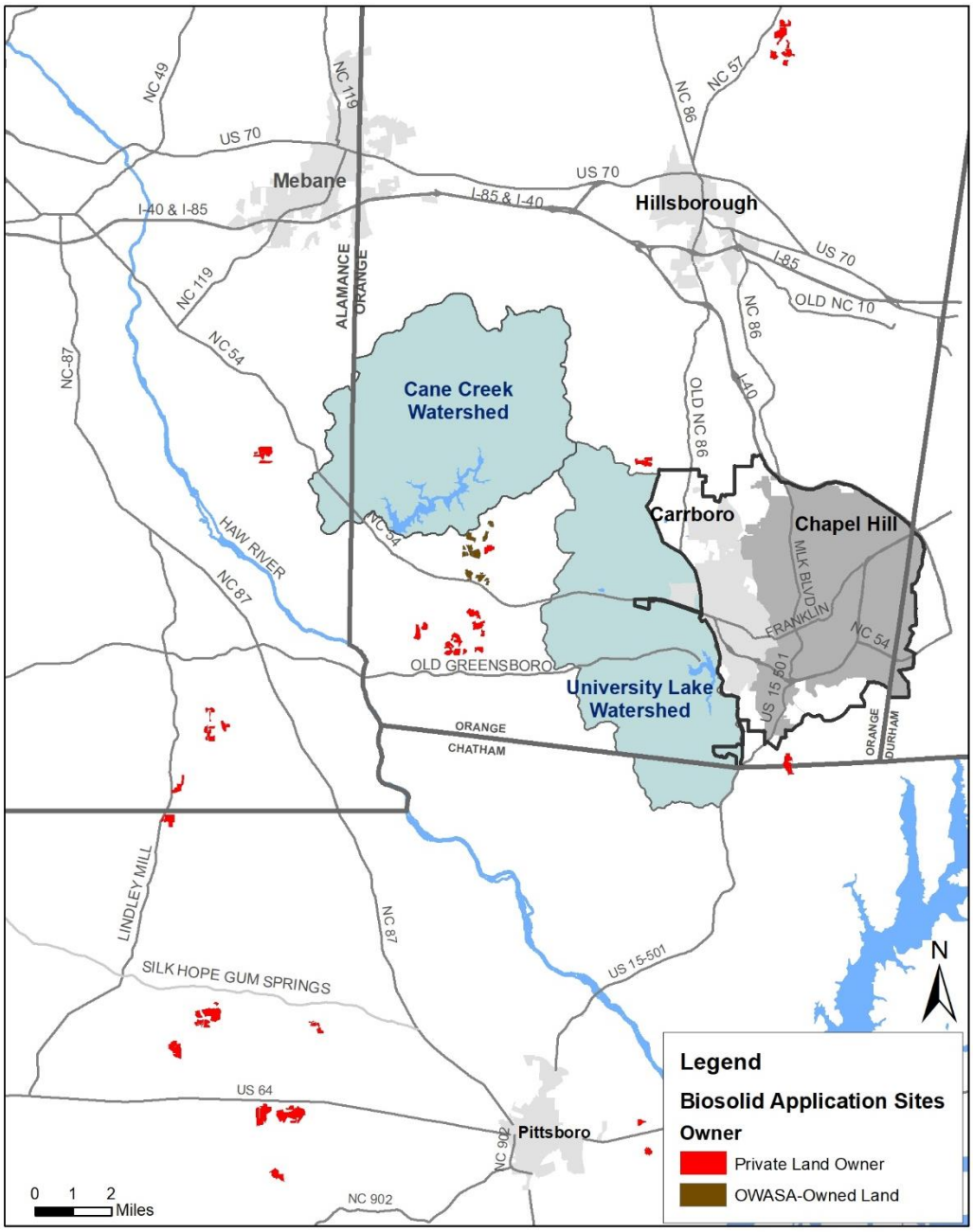


Figure 23. OWASA Biosolids Application Sites

Regulations

Federal and state regulations specify the agronomic rates at which biosolids may be land applied for designated crops (the maximum amount of biosolids that can be applied to a given field is currently determined by the nitrogen content of the biosolids and is limited to the nitrogen requirements of the particular crop to which it is being applied). OWASA closely monitors the application rates on each individual field and historically has applied at rates well below the maximum allowed by regulation. Some states also limit land application of biosolids based on the phosphorus content of the biosolids and the soil; however, North Carolina does not have such a loading limit. If North Carolina adopts this

approach, the amount of land needed to support our land application program would increase considerably.

The NC Department of Environmental Quality (DEQ) modified its regulations concerning biosolids in September 2018. The modifications reduced the set back from streams for Class B biosolids from 100 feet to 32.8 feet, and Class A setbacks remained at 100 feet. The State indicated that General Statute 150B-19.3(a) prohibits agencies from adopting a rule that imposes a more restrictive standard, limitation, or requirements than those imposed by federal law or rule. There is no federal setback requirement for Class A residuals and hence the existing 100-foot State requirement remains.

Technology and Research

Information on technology concerning our solids thickening process is provided in the Mason Farm WWTP section.

Energy Management

The primary energy uses of OWASA's biosolids management program are for vehicle fuel, biosolids loading, running the rotary press for dewatering, treating the nutrient-rich dewatering filtrate loads returned to the aeration process, and mixing the biosolids holding tanks.

Strategic Plan Elements

Strategic Initiative 3 includes a goal to make the right investments at the right time, and to base this information on our asset management program. Ensuring that our biosolids program meets federal and state requirements and protects public health, helps us meet the community's wastewater needs.

Actions Needed

Action Items	Timing	Board Action?	
		Yes	No
1. Evaluate the 75 percent liquid land application goal and report our performance to the Board	Annually as part of this report		X
2. Evaluate the amount of land in our biosolids program to ensure it is adequate to meet liquid land application goal	As needed (if farmers drop out of program)		X

Strategic Plan Progress Report

We identified six strategic initiatives with accompanying goals, actions, and measures of success. We believe that these initiatives and actions address each of our strategic themes and will result in positive change.



Strategic Initiative 1

Provide reliable and high quality supply of water for the next 50 years

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
Optimum mix of technically, environmentally, economically, and socially feasible water supply and demand management alternatives that meet projected demands and level-of-service objectives under a range of future conditions and uncertainties.	Update Long-Range Water Supply Plan (LRWSP) to include: > Desired level of service and water supply resiliency. > Supply and demand projections to incorporate best information from land use /growth management plans, University plans, climate change impact information, etc. > Evaluation of potential supply and demand management alternatives, including but not limited to: Jordan Lake as emergency supply; conservation and water use efficiency; expanded use of reclaimed water (including direct and indirect); quarry reservoir; etc. > Preferred mix of supply and demand management alternatives required to meet level-of-service objectives.	Updated plan provides a clear and responsible path forward to ensure a reliable and high quality supply of water for the next 50 years that is supported by stakeholders.	***The Board approved demand projections on March 14, 2019 and a list of supply and demand management alternatives on September 12, 2019. Staff is working to complete a draft evaluation of supply and demand management alternatives for discussion with the Board in January 2020.***
	Adopt Long-Range Water Supply Plan and begin implementation.	Adequate supply of high-quality water which meets customer needs for next 50 years across the range of assumptions and scenarios included in the Plan.	
Enhanced water supply reliability, reduced energy use, and reduced long-term life-cycle costs of water and sewer service through cost-effective water use efficiency (WUE), conservation, and Reclaimed Water (RCW) strategies.	Prepare Water Conservation Plan that includes a program to educate customers on the value and importance of water, best practices for reducing water use and monthly bills through conservation, WUE practices, and collaboration with Towns, County and others on conservation and WUE standards.	Reduce residential water use by X% (average is currently 4,000 gallons/month for individually-metered single-family residential accounts). (Target to be established.) Establish targets for other customer classes.	***The Water Conservation Plan will consist of three components: (1) demand management strategies that come out of the alternatives evaluation of the LRWSP, (2) behavioral changes that we will communicate through our Communications Plan and Affordability Outreach Plan, and (3) our Water Shortage Response Plan for use during droughts and operational emergencies.***

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
			This plan will be developed upon update of the Long-Range Water Supply Plan.
Maintain our Jordan Lake water supply allocation.	Application for Jordan Lake water supply allocation (Round 4) was submitted in November 2014.	Allocation request granted to OWASA by Environmental Management Commission (EMC).	***Complete. OWASA's Round 4 Jordan Lake water supply allocation was granted by the EMC on March 9, 2017.***
New or amended water transfer agreements with Town of Cary and City of Durham for OWASA to access our Jordan Lake water supply allocation through those entities when needed.	Coordinate with staff from the Town of Cary and City of Durham to determine terms and conditions for ensuring cost-effective access to our Jordan Lake allocation.	Successful adoption of new or amended water transfer agreements for OWASA to reliably and cost-effectively access our Jordan Lake water supply allocation when needed.	***After the update to the LRWSP, staff will evaluate with the Board the amount of water we need from Jordan Lake and the preferred way to cost-effectively access the allocation when needed. Staff continues to work with the City of Durham, Chatham County, and Town of Pittsboro to evaluate the feasibility and cost of constructing a new intake and water treatment plant on the west side of Jordan Lake.***



Strategic Initiative 2

Engage the Community

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
Engage stakeholders to understand their perceptions and expectations so that we make well-informed decisions about our services and so that we maintain their trust. Empower stakeholders with information so they use water wisely and protect water quality through proper use of our wastewater system. Provide stakeholders with timely information about projects, programs, and policies that are important to them and offer them meaningful opportunities to give their feedback so that we can continue to improve.	Prepare and implement Community Engagement Plans (CEPs) for all capital improvement projects and key initiatives. Implement meaningful engagement and public education activities with community partners.	Stakeholders trust OWASA to make informed decisions about our services. Positive feedback from customers and stakeholders about effectiveness of engagement work. Stakeholders have the information they need regarding projects, programs, and policies and they have opportunities to provide feedback on matters of importance to them. Increased participation by the public in OWASA engagement activities.	***Complete. Community Engagement Plans (CEPs) for all capital improvement projects.*** ***The Board approved OWASA's Communications and Community Engagement Plan on February 28, 2019. Numerous community engagement activities have been implemented since which have increased OWASA's engagement with customers in meaningful ways beyond transactional exchanges. Public participation rate and response has been positive. For example, increased attendance at our new community construction briefings directly in neighborhoods, implementation of a successful Youth Water Academy with the School Board (the School Board has invited us to implement a second Academy this Fall), public education sessions about water topics in partnership with the Chapel Hill Public Library, community dialogues in Cane Creek on Forest Management which changed the conversation from confrontational to collaborative, etc. Numerous communications products have been changed to align with OWASA's revitalized brand. The website is currently in the process of being redesigned accordingly.***

Strategic Initiative 3

Adopt financial management policies and budget decision processes to ensure affordable services and fiscal sustainability

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
Financial reserve funds set at appropriate level.	Review reserve policies during the annual budget development process to determine the desired level of reserve funds.	New or revised policies adopted, if appropriate.	***The Board reviewed OWASA's reserves policies in FY 2018 and determined the current approach to be appropriate. Analyzing and projecting reserve balances is a part of the annual budget development process.***
Efficient process which provides opportunities for stakeholder input and allows the Board of Directors to make well-informed budget and rate decisions.	During the annual budget development process, review Capital Improvement Program (CIP) investment practices.	New or revised CIP investment practices are adopted, if appropriate.	***In December 2018, after considering alternative approaches for developing the annual operating expense budget, the Board determined that the current approach met the needs of the organization. The Finance Committee is scheduled to meet in October 2019 to discuss potential enhancements to the process for Fiscal Year 2021 and beyond.***
The right investments at the right time to sustain the community's essential water, wastewater and reclaimed water assets.	Comprehensive Asset Management Program report was completed in March 2016.	Service levels are part of the Asset Management Program report.	***Complete. The Asset Management Program report was updated and posted to the OWASA website in July 2017.***
Rates, fees and charges that meet objectives.	Evaluate possible rate structure changes for customer classes to include possible update to System Development Fees.	A rate structure that fairly and fully recovers revenues, promotes water conservation, promotes affordability, and is understood by customers.	***Based on results of a rate study, the Board changed the water commodity rate for the multi-family master-metered customer class from seasonal rates, which are higher in the warmer months from May to September and lower the rest of the year, to a year-round rate. Several alternative rate structures were considered and the Board agreed to reconsider alternatives once the AMI project is near completion. Additionally, in accord with a new North Carolina statute, the Board approved a new method for calculating System Development Fees. Application of the new method resulted in reductions in System Development Fees of between 10% and 40%.*** ***The project to implement AMI was completed in June 2019. The Board has not yet decided whether or when to consider alternative rate structures.***

Strategic Initiative 4

Implement an Energy Management Program

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
Cost-effective measures to reduce our use of energy, related energy costs, and associated greenhouse gas (GHG) emissions.	Develop an Energy Management Program that includes: > Goals for energy reduction by 2030 against a 2010 baseline. > Ongoing assessment of energy use, costs, and GHGs. > Assessment of the energy performance of our equipment, operations, and buildings and identification of opportunities for energy savings and the associated return on investment. > Prioritized energy savings opportunities. > Implementation of selected energy management and energy efficiency projects as part of CIP and annual budget. > Evaluation and prioritization of potential renewable energy strategies. > Feedback from community stakeholders.	Program provides a clear and responsible path forward for effective energy management. Energy cost savings (costs avoided) achieved from energy management, energy efficiency measures, and renewable energy measures. Amount of grants, rebates, incentives, etc. received to fund energy management efforts. Percent reduction in our GHGs compared to baseline year.	***Complete. On September 8, 2016, the Board approved OWASA's Energy Management Program and associated Stakeholder Engagement Plan. In addition, the Board approved using a separate social cost of carbon in the business case evaluation of clean energy projects at OWASA. OWASA's Energy Management Program, as explained in the 2019 Energy Management Plan Update, is an iterative process of system and strategy evaluation.*** ***Since 2014, OWASA has received over $252,000 in rebates to fund energy management efforts.*** ***In Fiscal Year 2019, OWASA spent about $140,000 less on electricity and natural gas than in Fiscal Year 2010. This is despite increasing energy rates. We estimate that we avoided about $400,000 in energy expenses due to energy efficiency and conservation efforts.*** ***Since 2010, we have reduced the GHG emissions associated with our use of electricity and natural gas by 40%.*** ***In September 2019, the Board authorized staff to pursue a public-private partnership (i.e. solar lease) for the development of solar photovoltaic systems on OWASA facilities. If all sites are developed as proposed, OWASA will generate over 1 million kWh of solar electricity each year.***
	Adopt Energy Management Plan and begin implementation of Energy Management Program.	Continued reduction in electricity use (kilowatt-hours) and natural gas use (therms).	***Complete. On April 13, 2017, the Board approved the Energy Management Plan that identifies strategies to meet the energy management goals and objectives set by the Board. The Plan is an output of OWASA's Energy Management Program which was established to identify cost-effective measures to reduce our use of energy, related energy costs, and associated GHG***

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
			emissions. On March 8, 2018, the Board approved an Updated Energy Management Plan. ***Since 2010, OWASA has reduced its use of purchased electricity by 29% by implementing cost-effective energy efficiency projects and conservation measures. In addition, we have reduced our use of purchased natural gas by 26% since 2010.***



Strategic Initiative 5

Implement Advanced Metering Infrastructure

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
Cost-effective, accurate, reliable and timely water metering information for enhanced customer service.	System procurement and implementation planning. Develop and implement Community Engagement Plan.	Procure a system within budget constraints that meets OWASA's needs. Develop implementation plans that will effectively mitigate risks identified in the AMI Feasibility Study and will fully inform and engage customers.	***Complete. The Board awarded the contract to Mueller Systems in May 2017 following extensive procurement and contract negotiation processes conducted by OWASA staff and our consultants. The total capital outlay for this project was $5.3 million, which was about equal to the budgeted amount. Annual operating and maintenance costs are approximately $114,000. The project was financed with low-interest loans from the State of North Carolina and has a simple payback period of just less than 10 years.*** ***A comprehensive set of implementation performance standards were included in the contract documents to mitigate risks. Subsequent implementation planning has used these standards as the foundation and guidance for document development.*** ***OWASA has engaged a robust community engagement strategy throughout the project. In 2016, we focused on raising awareness of the overall investment in and potential of the AMI system. We communicated directly with customers through the installation phase. In March 2019, we rolled out the Agua Vista Web Portal to all OWASA customers. We are encouraged that over 32% of eligible customers have now registered for the Portal and we have used it to alert customers of over 6,000 potential leaks. This***

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
			communication strategy is part of the Community Engagement Plan approved by the Board in December 2016.
	System deployment.	Ensure the system delivers accurate, reliable and timely water use information for billing purposes.	***Complete. Full scale deployment began in March 2018 and was completed by June 2019. The network is fully operational with staff maintaining a 99.5% read rate for meters.***
		Processes are in place to ensure customers are provided accurate and timely information about their water use and prompt notifications about potential leaks.	***Complete. Automatic notifications regarding potential leaks are being sent to customers from the WaterSmart customer portal.***
		Reduce energy use and carbon footprint associated with meter reading and field service functions.	***Complete. We have virtually eliminated manual meter reads and have reduced site visits related to service requests by over 80%.***
		Customer feedback on their experiences with the system installation, process changes and use of the portal is mostly positive.	***We experienced a very low volume of customer complaints during the installation phase and have received many positive comments from customers regarding leak notification and the customer portal.***

Strategic Initiative 6

Develop a plan and policy framework for long-term management and disposition of OWASA lands

GOALS	ACTIONS	MEASURES OF SUCCESS	*PROGRESS*
Land assets provide the expected value to fulfill OWASA's mission and the assets are effectively managed.	Develop a long-term plan for sustainable management of OWASA forest lands (not including Cane Creek Mitigation Tract, which is already being managed). Management options range from "no active management" to comprehensive management that includes a variety of activities such as thinning, small seed tree cuts, small area clear-cuts, etc.	Forest lands are effectively managed to meet the goals provided in the Forest Stewardship Plan.	***On January 9, 2019, the Board of Directors supported a new incremental approach to forest management and on April 11, 2019, the Board approved a Community Engagement Plan for the approach. OWASA held a community meeting on June 20, 2019. The Board approved a Vision and Guiding Principles along with the overall approach to manage OWASA's forest land on September 26, 2019. Staff is currently prioritizing forest land for management in accordance with the Board approved approach.***
	Evaluate land assets to determine if the asset is needed, what degree of ownership is needed, and if the asset should be sold.	Land assets provide expected value to meet OWASA's current and future needs.	***At a meeting on September 26, 2017, the NRTS Committee reviewed several options to evaluate OWASA land to determine if any should be sold. The Committee unanimously agreed that the Board should wait to decide whether to do an analysis after we work through the forest management process.***

Administering Our Strategic Plan

We will provide regular updates on our progress towards achieving our Strategic Plan goals, including measures of success, which can be found on our website. We welcome your questions or comments about our Strategic Plan or any of our services and programs. You may contact us by:

- Phone: 919-968-4421
- E-mail: info@owasa.org
- Fax: 919-968-4464
- Address: 400 Jones Ferry, Carrboro, NC 27510

There are other high priority tasks that we will address over the next couple of years that are not included in our Strategic Plan because they do not require strategic action at this time. However, these tasks may require action by the Board in the future.

1. Continue to increase community awareness of options to manage and reduce OWASA bills and empower low-income customers and the local agencies that serve them with information and tools to manage and reduce OWASA bills through the Affordability Outreach Program.

   The Board approved OWASA's first Affordability Outreach Program Plan in October 2015 and has received annual updates through 2019. In 2019, the Program focused on promoting the Agua Vista Web Portal as an essential resource to save money by saving water.

2. Evaluate alternative employee compensation strategies to encourage and reward high performance as part of a Total Compensation Study.

   The Board reviewed compensation of employees and adopted a resolution in December 2017 whereby pay increases will be provided, based on performance, to 3 of the 4 performance-rating categories. Merit Increases for "Meets Expectations" ratings are to be no less than 2.9 percentage points greater than the Cost of Labor Adjustment (COLA).

3. Develop and implement an Inclusion and Diversity Plan for the organization.

   Our Diversity and Inclusion plan is well established. Three groups were formed to help guide our work: Diversity Resource Group, Diversity Recruitment Group and Diversity Leadership Group. An Organizational Assessment took place with employees and the Board. As a result of the Assessment, employees provided forty (40) general recommendations in seven (7) categories. Our consultant, VISIONS, provided additional recommendations in four (4) categories. Employees also provided twenty-six (26) recommendations in four (4) categories for recruitment and retention. All of the recommendations have been prioritized by year and work is well underway.

   Additional key activities include:
   - ***Staff continues to engage with agencies and organizations to seek assistance in recruitment.***
   - ***We continue to solicit OWASA employees for employment referrals.***
   - ***Recruitment Plans are prepared for each recruitment to include reviewing local census data to identify under-represented groups.***
   - ***A comprehensive review of procedures, policies and documents related to recruitment and selection was conducted by Human Resource staff and a VISIONS expert.***
   - ***Articles highlighting diversity are in each employee newsletter.***
   - ***A comprehensive administrative guide for recruitment was created.***
   - ***The Performance Review Self-Assessment has been updated.***
   - ***NEOGOV software has been implemented to include job interest feature.***

- ***Additional employees have been trained on the newly developed standard processes for interview panels and making employment decisions.***
- ***A Welcome Team has been developed and trained to improve the onboarding process.***
- ***Mandatory training for Supervisors took place from August through November 2018.***
- ***Voluntary Employee training took place from August through October 2018.***
- ***Additional employees received the initial 16 hours of D&I training as well as standard processes for interview panels, making employment decisions and Implicit Bias and Microaggressions in 2019.***
- ***Various core trainings have been offered to all employees.***
- ***The three diversity groups developed draft metrics for our D&I program and will report on them annually.***
- ***The Board of Directors has had training sessions with VISIONS and additional training is forthcoming.***

We provide an Annual Review and Update of Strategic Trends and Utility Planning Issues to the Board. This report will be modified as a companion document to this Strategic Plan for the Board's consideration in October 2019.

We will routinely update and amend our Strategic Plan as necessary, and we will keep our customers and stakeholders informed of significant changes.

Summary

As your community-owned water utility, we are committed to providing reliable, high quality water, wastewater and reclaimed water services for our customers, now and into the future. Our Strategic Plan is one of many tools we use to effectively manage our essential responsibilities to the Carrboro-Chapel Hill community. We will continue to work hard to provide excellent service so that if our customers could choose their water utility, they would always select OWASA.

Agenda Item

- Financial Report for the Three-Month Period Ended September 30, 2019

Purpose

- To inform the Board of Directors of OWASA's financial performance and fiscal position.

Background

- The financial report consists of a Statement of Net Position, an Income Statement that includes a budget to actual comparison, graphical presentations of financial performance indicators and a Financial Management Policy Report Card.

- Highlights of the report include:

    - All but one of our financial performance targets were met.

    - Operating Revenues for the period were about $397,000 less than budget.

    - System Development Fees were about $136,000 over budget.

    - Operating Expenses were about $971,000 less than budget.

    - Net Income less Debt Service was about $732,000 over budget. OWASA is a nonprofit entity. Net Income less Debt Service is used to fund investments in capital improvement projects and reserves.

    - Capital Improvements Program expenditures were approximately $421,000 less than the amended budgeted.

Action Needed

- Receive and discuss the financial report for the three-month period ended September 30, 2019.

October 24, 2019

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

MEMORANDUM

To: Board of Directors

Through: Ed Kerwin

From: Stephen Winters, CPA

Date: October 18, 2019

Subject: Financial Report for the three-month period ended September 30, 2019

Purpose

The financial report for the three-month period ended September 30, 2019 is presented to inform the Board of Directors of OWASA's financial position and financial performance in relation to budget.

Contents

- Statement of Net Position
- Income Statement
- Graphs of Key Performance Indicators
- Financial Management Policy Report Card

Fiscal Performance

- As shown on page 10 of the report, all financial performance measurement targets were met for the period except for meeting the target balance in the working capital reserve. At the end of the period, the balance was about $7.9 million less than the target. This will be resolved when we secure funding from loans from the state of North Carolina in the coming months and issue water and sewer revenue bonds in November 2019. Total reserves as of September 30, 2019 was approximately $12 million.
- Average drinking water sales for the period was 6.39 million gallons per day (MGD), 6.69 was projected. Combined drinking and reclaimed water sales for the period averaged 7.90 MGD versus a projection of 8.11.
- Total operating revenue was about $397,000 less than budget. It is too early in the year to determine whether revenue will be less than budget for the year but we will monitor and inform the Board as needed.
- Revenue from new system connections (system development fees) was over budget by about $136,000.
- Total operating expenses for the period were 16.8% or about $971,000 less than budget.
    - General and administrative expenses were under budget by about $202,000. Consulting costs for assistance in complying with the American Water Infrastructure Act of 2018, work associated with the long-range water supply plan, and support services in human resources were about $97,000 under budget. The rest of the variance is due primarily to position vacancies.
    - The Water Supply and Treatment department expenses were under budget by about $434,000. Chemicals expense was under budget by about $190,000 and maintenance expense was under budget by about $132,000:

        - The price of caustic soda has dropped. (Caustic soda is used to adjust pH levels which helps soften water and inhibit corrosion.)
        - We are using less sodium permanganate than anticipated. (Sodium permanganate is used to help mitigate taste and odor issues and reduce total organic carbon (TOC) in drinking water.)
        - Maintenance expense was under budget because several projects have not yet happened.
    - Water distribution expenses were under budget by 6% or about $46,000.
    - Wastewater treatment expenses were under budget by about $220,000. Maintenance expense was under budget by about $126,000 because certain planned projects have not yet occurred.
    - Wastewater collection expenses were under budget by about $70,000 due primarily to less than expected maintenance costs for the period.
    - Energy costs across the organization were under budget because not all September invoices for electricity were received and processed prior to the end of the period.
- Net Income less Debt Service for the period was approximately 20.2% or $732,000 greater than budget. OWASA is a nonprofit entity. Net Income less Debt Service is used to fund investments in capital improvement projects and reserves.
- Capital Improvements Program (CIP) Summary

  CIP expenses for the first quarter of FY 2020 totaled $4.0 million, versus the projected $4.4 million reflected in the baseline budget for this period. For the fiscal year, CIP expenses are projected to total $25.4 million, or 96% of budgeted funds. The uncertainty in this projected amount is tied primarily to the timing of several construction projects currently expected to be bid in winter or early spring.

  There are several major projects currently in construction at various facilities including the Water Treatment Plant Sedimentation Basin Rehabilitation, University Lake Pump Station Rehabilitation, Wastewater Treatment Plant Solids Improvements and Headworks Rehabilitation, and Rogerson Drive Pump Station Rehabilitation Phase 2. In addition, construction was active or imminent for several water main replacements throughout the distribution system, including water mains on Manning Drive, Country Club, Fordham Service Road, Dobbins Drive near Erwin Road, Honeysuckle Court, and Jean Court. As reported to the Board at the October work session, the emergency repair of the Rogerson Drive Force Main at Raleigh Road near Rogerson Drive, ongoing since April, is entering a testing and commissioning period prior to completion of surface restoration at the site. In addition to these construction projects, detailed design work continues on the several large projects to be bid in the winter or early spring, and planning and preliminary engineering is underway for numerous other projects or studies. In total, over 70 CIP projects were active during the first quarter.

  Hiring efforts continue for the Utilities Engineer vacancy created by the recent internal promotion of Allison Spinelli to Asset Manager. The vacancy is not currently expected to have a significant effect on the FY 2020 projection given timing of major projects.

  The effectiveness of outreach efforts to minority and women-owned business enterprises (MWBE) will continue to be a focus during upcoming construction bid opportunities. Staff will provide an update at the December work session about information gathered from other utilities and agencies with respect to outreach activities that may be implemented as well as overall MWBE participation results.

Action Requested

Receive and discuss the financial report.



Stephen Winters, CPA
Director of Finance and Customer Service

Orange Water and Sewer Authority

Financial Report
For the Three-Month Period Ended
September 30, 2019

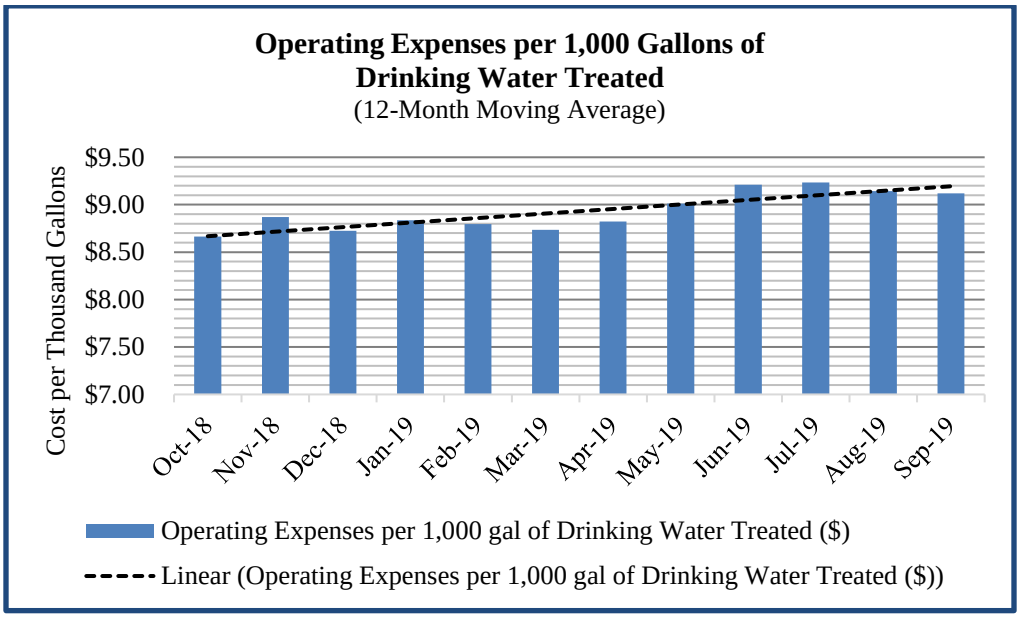
Orange Water and Sewer Authority
Statement of Net Position
September 30, 2019
(unaudited)

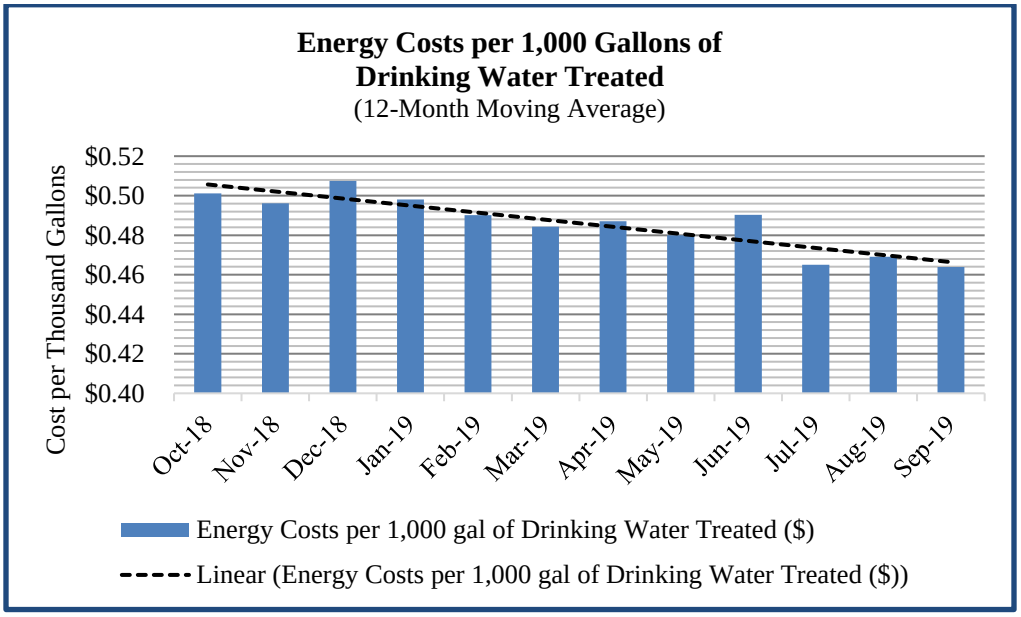
Assets	
Current Assets	
Cash	$11,921,895
Receivables	4,607,885
Inventory	1,381,460
Prepaid expenses	278,795
Restricted cash	1,795,981
Total Current Assets	19,986,016
Noncurrent Assets	
Capital assets (net of depreciation)	278,796,161
Other noncurrent assets	50,888,501
Total Noncurrent Assets	329,684,662
Total Assets	$349,670,678
Liabilities and Net Position	
Current Liabilities	
Accounts payable and accrued expenses	$1,277,726
Unearned income	139,112
Customer deposits	1,205,139
Total Current Liabilities	2,621,977
Noncurrent Liabilities	
Bonds payable	57,299,218
Other noncurrent liabilities	14,302,693
Total Noncurrent Liabilities	71,601,911
Net Position	
Contributed capital	118,155,824
Net position at the beginning of the year	154,263,029
Year-to-date accrual basis net income	3,027,937
Total Liabilities and Net Position	$349,670,678
Net income reconciliation:	
Accrual basis net income	$3,027,937
Depreciation, interest, other post-employment benefits expenses	2,796,634
Modified accrual basis net income	$5,824,571

Orange Water and Sewer Authority
Income Statement
For the Three-Month Period Ended September 30, 2019
(unaudited)

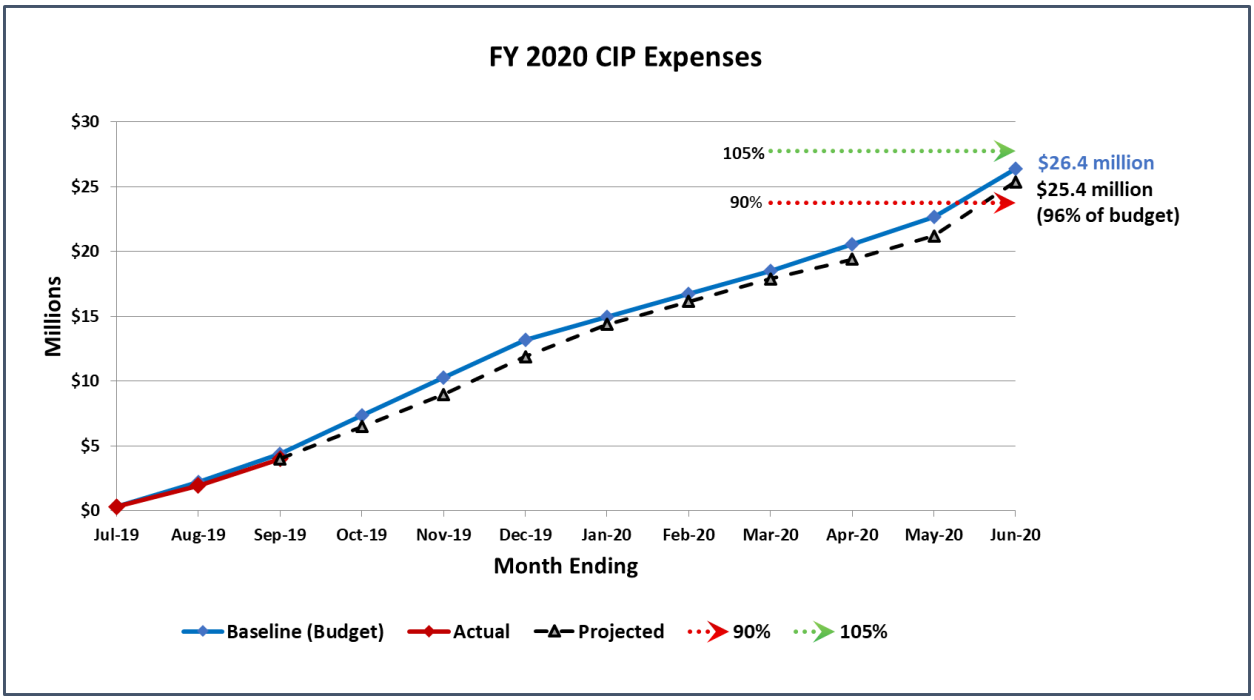
	Actual through September 30, 2019	Budget through September 30, 2019	Variance (effect on net change in Fund Balance)	Percent Variance
Operating Revenue				
Water	$5,281,152	$5,168,993	$112,159	2.2%
Sewer	4,473,574	4,902,555	(428,981)	(8.8)
Reclaimed Water	165,676	208,764	(43,088)	(20.6)
Service Initiation Fees	10,665	38,481	(27,816)	(72.3)
Other	224,810	250,359	(25,549)	(10.2)
Refunds and Allowances	(36,533)	(53,142)	16,609	31.3
Total Operating Revenue	10,119,344	10,516,010	(396,666)	(3.8)
Non-Operating Income (Expense)				
System Development Fees	497,954	362,223	135,731	37.5
Interest	4,061	11,601	(7,540)	(65.0)
Total Non-Operating Income	502,015	373,824	128,191	34.3
Total Income	10,621,359	10,889,834	(268,475)	(2.5)
Operating Expense				
General and Administrative	1,662,050	1,863,927	201,877	10.8
Water Supply and Treatment	1,237,360	1,671,271	433,911	26.0
Water Distribution	728,231	774,339	46,108	6.0
Wastewater Treatment	961,391	1,181,147	219,756	18.6
Wastewater Collection	207,756	277,485	69,729	25.1
Total Operating Expense	4,796,788	5,768,169	971,381	16.8
Net Income (modified accrual)	5,824,571	5,121,665	702,906	13.7
Debt Service	1,469,897	1,499,481	29,584	2.0
Net Income less Debt Service	4,354,674	3,622,185	732,490	20.2
CIP Expenditures	3,983,000	4,404,000	421,000	9.6
Capital Equipment Expenditures	47,154	989,700	945,546	95.2
Net Change in Fund Balance	$324,520	($1,771,516)	$2,906,036	

Orange Water and Sewer Authority
Select Financial Data
For the Three-Month Period Ended September 30, 2019





Orange Water and Sewer Authority
Select Financial Data
For the Three-Month Period Ended September 30, 2019

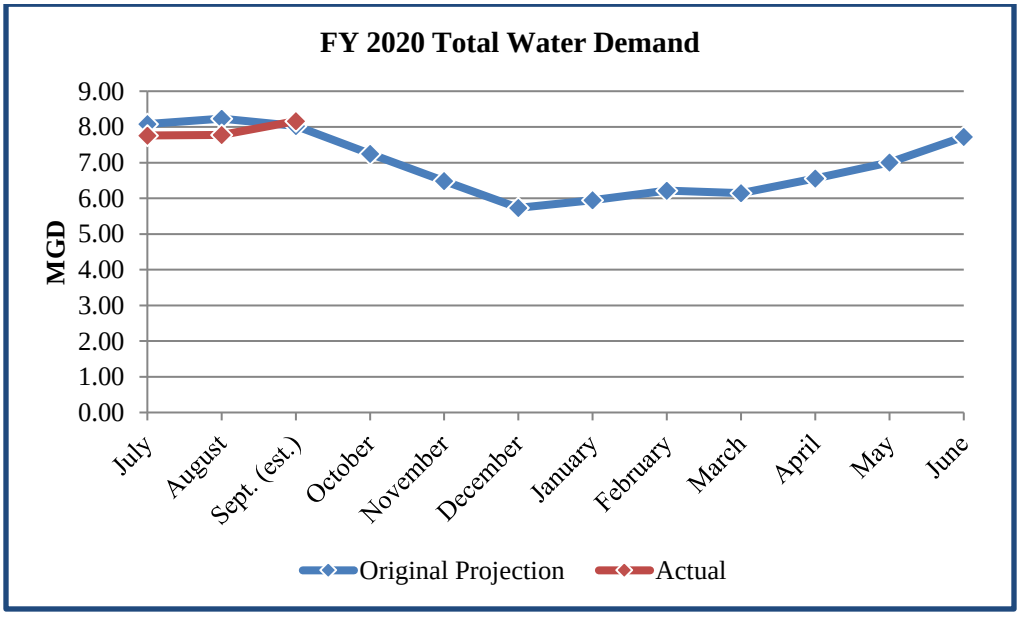


Orange Water and Sewer Authority
Select Financial Data
For the Three-Month Period Ended September 30, 2019

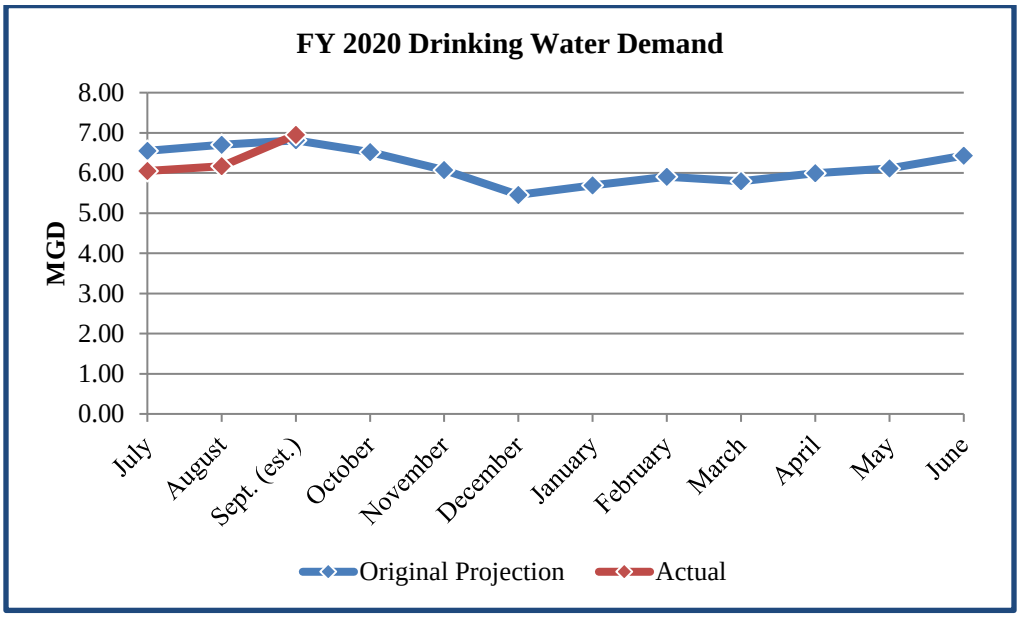
FY 2020 Water Sales Projection (Average Day)

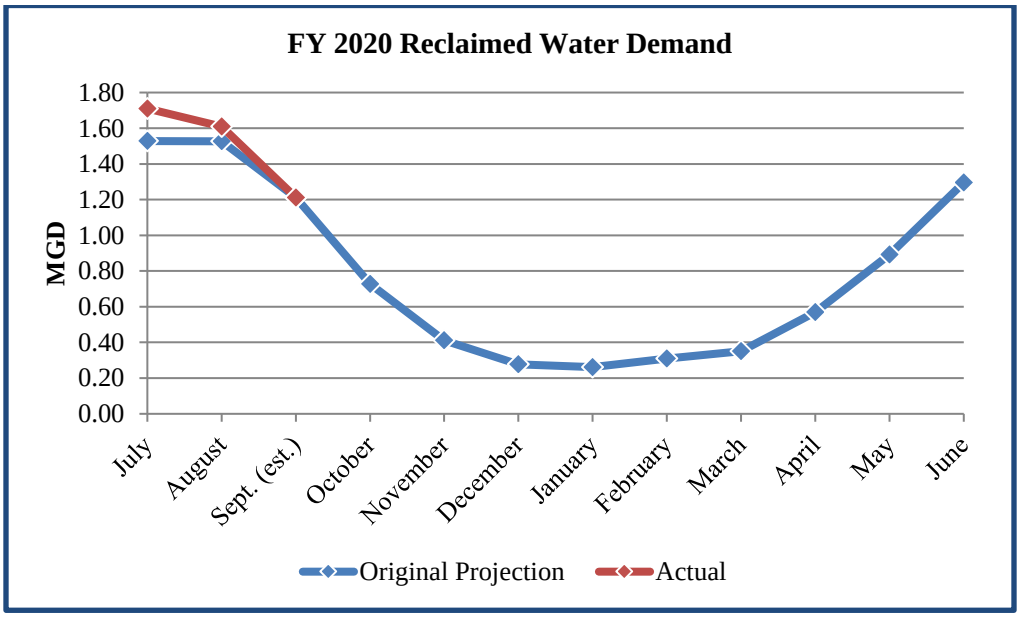
	Original FY 2020 Sales Projections		Actual FY 2020 Water Sales		Revised FY 2020 Sales Projections	
	DW	RCW	DW	RCW	DW	RCW
July	6.55	1.53	6.05	1.71	6.05	1.71
August	6.70	1.53	6.17	1.61	6.17	1.61
September	6.81	1.21	6.95	1.21	6.81	1.21
October	6.52	0.73			6.52	0.73
November	6.07	0.41			6.07	0.41
December	5.46	0.28			5.46	0.28
January	5.69	0.26			5.69	0.26
February	5.91	0.31			5.91	0.31
March	5.79	0.35			5.79	0.35
April	5.99	0.57			5.99	0.57
May	6.11	0.89			6.11	0.89
June	6.43	1.30			6.43	1.30
Average	6.17	0.78	6.39	1.51	6.08	0.80

Estimates shown in red

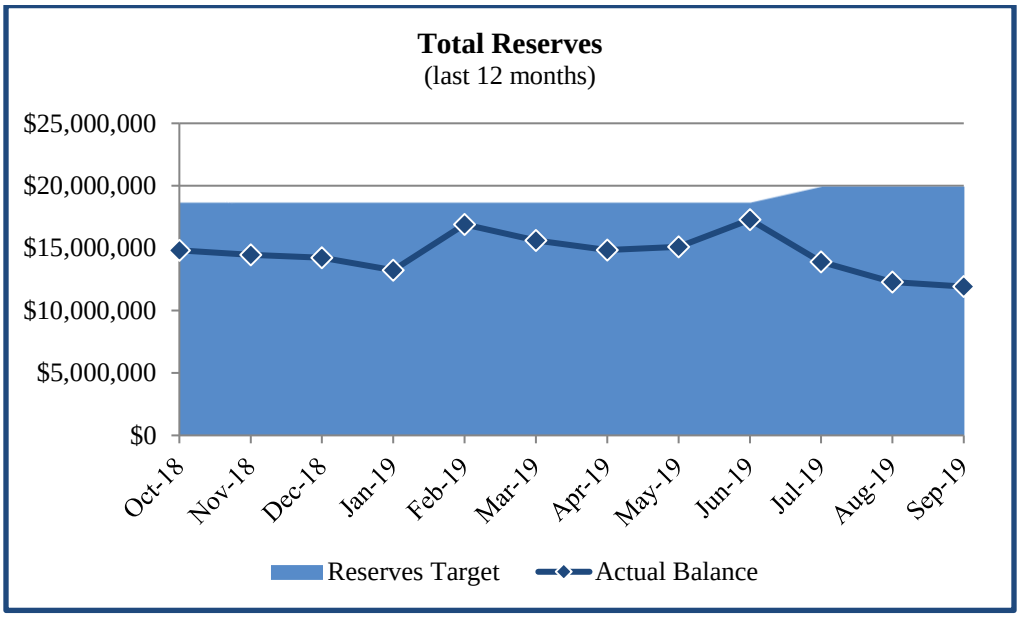


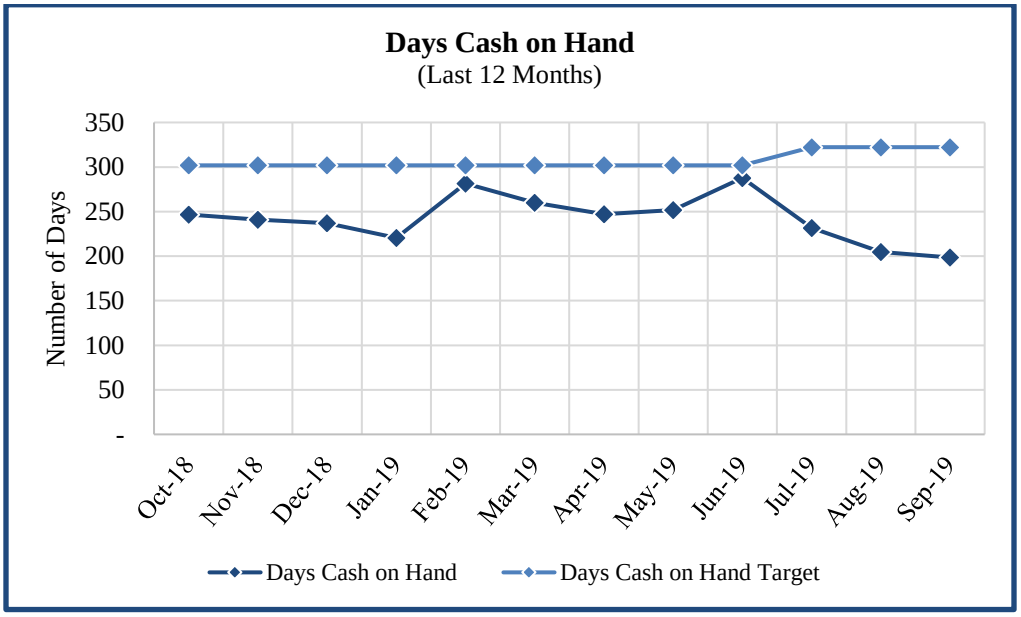
Orange Water and Sewer Authority
Select Financial Data
For the Three-Month Period Ended September 30, 2019



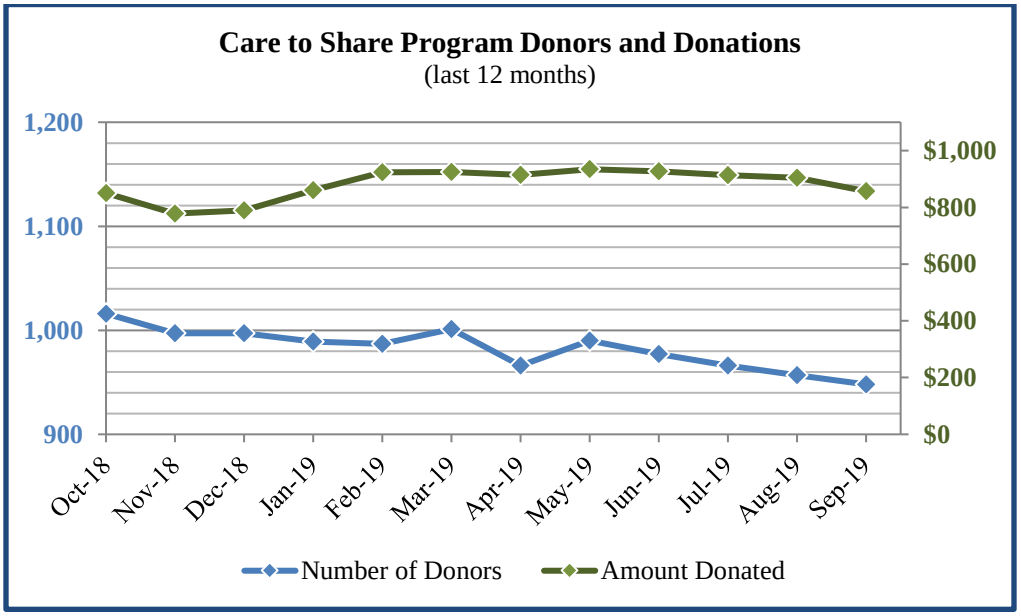


Orange Water and Sewer Authority
Select Financial Data
For the Three-Month Period Ended September 30, 2019





Orange Water and Sewer Authority
Select Financial Data
For the Three-Month Period Ended September 30, 2019



Orange Water and Sewer Authority
Financial Management Policy Report Card
For the Three-Month Period Ended September 30, 2019

Measurement	Objective	FY19 Results	FY20 Goal	YTD FY20 Results
Working Capital Reserves	Greater of four months Operating Expenses or 20% of succeeding three years CIP	$11.5M	$13.6M	$5.7M
Capital Improvements Reserve	2% of Net Capital Assets (Funding $400,000 per year until reach goal of approximately $6M)	$4.0M	$4.4M	$4.4M
Rate/Revenue Stabilization Reserve	5% of annual Water and Sewer Revenue	$1.8M	$1.9M	$1.9M
Debt Burden to Asset Value	Total Debt not more than 50% of Total Assets	24%	≤ 50%	21%
Sufficiency of Revenues above Debt Requirements[3]	Annual Debt Service no more than 35% of Gross Revenue	19%	≤ 35%	19%
Cash Financing of Capital[1]	Annual revenues and reserves provide at least 30% of CIP funding	49%	≥ 30%	44%
Debt Service Coverage Ratio[3]	Annual Net Income not less than two times Annual Debt Service	2.1	2.0	2.1
Service Affordability Ratio[2]	Average annual OWASA bill not more than 1.5% of area median household income	1.38%	1.5%	1.35%

M = million

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[1] Cash Financing of Capital based on 5-Year CIP Budget and potential borrowing during the same period.
[2] FY 2020 Calculation based on median household income of $67,426 (per U.S. Census Bureau's 5-year American Community Survey estimates for 2013 - 2017 MHI (in 2017 dollars) and average monthly household water use of 4,000 gallons.
[3] Calculation based on the FY 2020 Annual Budget until full-year results are available.