

ENVIRONMENTAL FINANCE CENTER AT THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL  
HILL SCHOOL OF GOVERNMENT



## **REPORT 2**

# Extrapolating to a More Comprehensive Drinking Water and Wastewater Infrastructure Needs Estimates from the EPA Needs Surveys for the State of North Carolina

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March 2016

Report to the North Carolina State Water Infrastructure Authority and  
the North Carolina Department of Environmental Quality Division of  
Water Infrastructure

This report is a product of the Environmental Finance Center at the University of North Carolina, Chapel Hill School of Government. Findings, interpretations, and conclusions included in this report are those of the authors and do not necessarily reflect the views of the NC Department of Environmental Quality, the University of North Carolina, or the UNC School of Government.

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## Executive Summary

In this report, we develop and implement a simple methodology to extrapolate water and wastewater infrastructure needs estimates for the State of North Carolina by adjusting EPA needs surveys data as a starting point and using recent CIP information for a sample of utilities. This methodology is the one described as Option 2 in the list of alternative methods that the State of North Carolina can employ to assess the infrastructure needs of the state for planning purposes (see Report 6). It is a methodology that can be relatively quickly replicated in future years.

We estimate that the total 20-year infrastructure needs for the state are likely to be in the range of **\$10.8 billion - \$15 billion for drinking water systems** and **\$7.4 billion - \$11.1 billion for wastewater systems**. We therefore estimate that the combined 20-year water and wastewater infrastructure needs in the State of North Carolina are in the range of \$18.2 billion – \$26.1 billion. These estimates may be lower than actual needs, however, because they were derived by extrapolating from the EPA needs survey estimates that are, by design, narrower in scope than a comprehensive assessment of all infrastructure needs in the state (see Report 1). Furthermore, they exclude the infrastructure needs of decentralized wastewater systems as well as centralized wastewater systems that are not owned by local governments.

**Table of Contents**

Introduction ..... 1

Extrapolating the Drinking Water Capital Infrastructure Needs ..... 1

    Statistics on North Carolina’s Drinking Water Systems ..... 1

    Statistics on the Drinking Water Needs Data from the 2011 DWINSA ..... 2

    Examples of Differences between 2011 DWINSA Needs Data and the Current CIP Totals for Drinking Water Infrastructure ..... 3

    How were the Needs Estimates Adjusted from the 2011 DWINSA? ..... 5

    The 20-Year Drinking Water Infrastructure Needs of Active Community Water Systems in NC ..... 6

Extrapolating the Centralized Wastewater Capital Infrastructure Needs ..... 7

    Statistics on North Carolina’s Centralized Wastewater Systems Owned by Local Governments ..... 7

    Statistics on the Wastewater Needs Data from the 2012 CWNS ..... 8

        Incomplete Census of Infrastructure Needs ..... 9

        Incomplete Assessment of Infrastructure Needs ..... 10

    Examples of Differences between 2012 CWNS Needs Data and the Current CIP Totals for Wastewater Infrastructure ..... 10

    How were the Needs Estimates Adjusted from the 2012 CWNS? ..... 12

    The 20-Year Infrastructure Needs of Centralized Wastewater Systems Owned by Local Governments in NC ..... 14

Conclusion ..... 14

## Acronyms

<b>AFIR</b>	Annual Financial Information Report
<b>CCI</b>	Construction Cost Index
<b>CIP</b>	Capital Improvement Plan
<b>CPI</b>	Consumer Price Index
<b>CWS</b>	Community Water System
<b>CWNS</b>	Clean Watersheds Needs Survey
<b>DWI</b>	Division of Water Infrastructure (NC Department of Environmental Quality)
<b>DWINSAs</b>	Drinking Water Infrastructure Needs Survey & Assessment
<b>EFC</b>	The Environmental Finance Center at the University of North Carolina, Chapel Hill
<b>EPA</b>	Environmental Protection Agency
<b>LGC</b>	Local Government Commission
<b>NTNCWS</b>	Non-Transient, Non-Community Water System
<b>OWASA</b>	Orange Water and Sewer Authority
<b>SDWIS</b>	Safe Drinking Water Information System

## Introduction

This report presents an analysis of drinking water and wastewater infrastructure needs in the State of North Carolina. Every four years, EPA estimates the infrastructure needs throughout the country, including in North Carolina, through the DWINSA and CWNS. These national infrastructure needs surveys, however, have some limitations in estimating the true total needs for each state, as explained in Report 1. In this report, we adjust and extrapolate the needs estimates from the 2011 DWINSA and 2012 CWNS to calculate more comprehensive estimates of infrastructure needs in the state. The methods used to adjust the needs estimates from the EPA surveys are explained in this report.

The first section of this report provides a brief overview of community water systems statewide, needs estimated in the 2011 DWINSA, and the EFC’s extrapolation of the 20-year drinking water infrastructure needs for community water systems in the state. The second section presents the same information for public wastewater systems, extrapolating the wastewater infrastructure needs for the state from the 2012 CWNS.

## Extrapolating the Drinking Water Capital Infrastructure Needs

In the 2011 DWINSA, EPA estimated that the 20-year drinking water infrastructure needs for the State of North Carolina was close to \$10 billion. Because the DWINSA focuses only on certain types of infrastructure needs, the actual total needs for the state’s drinking water systems are higher. The DWINSA assesses infrastructure needs at the water system level – not community or utility level; hence, extrapolating the infrastructure needs for the state must also occur at the water system level.

## Statistics on North Carolina’s Drinking Water Systems

Based on Public Water Supply Section’s SDWIS database on July 28, 2015, there were 2,024 active community water systems. The majority of these water systems are small, investor-owned water systems, although the majority of North Carolinians are served by local government-owned water systems. There were 13 large water systems serving more than 100,000 people each.

<b>Large Systems with Service Populations &gt;=100,000</b>		
<ul style="list-style-type: none"> <li>• Charlotte Water</li> <li>• Raleigh</li> <li>• Winston-Salem</li> <li>• Greensboro</li> <li>• Durham</li> <li>• Fayetteville Public Works Commission</li> <li>• Davidson Water, Inc.</li> </ul>	<ul style="list-style-type: none"> <li>• Cary</li> <li>• Cape Fear Public Utility Authority</li> <li>• Asheville</li> <li>• Onslow Water and Sewer Authority</li> <li>• Union County</li> <li>• High Point</li> </ul>	
		13
<b>Medium Systems with Service Populations 3,301-99,000</b>		261
<b>Small Systems with Service Populations &lt;=3,300</b>		1750
<b>Total</b>		<b>2,024</b>

These 2,024 community water systems serve a reported 7,923,328 people, or 3,001,910 connections. However, two of the water systems are wholesale systems that have few connections and may be double-counting the retail service population of their purchasing systems: (A) Neuse Regional Water and Sewer Authority which reports 8 connections & 93,238 people; and, (B) Martin County Regional Water and Sewer Authority reports which reports 2 connections and 10,215 people.

Excluding these service populations, it appears that 7,819,875 people are served by active community water systems (as of July 2015). The State of North Carolina population was estimated to be 9,943,964 in the U.S. Census Bureau’s 2014 Population Estimate, thus approximately 79% of North Carolinians are served by a community water system.

### Statistics on the Drinking Water Needs Data from the 2011 DWINSA

The table below summarizes the state’s drinking water needs estimates from the 2011 DWINSA, broken down by the strata used in the needs survey (i.e. large versus medium versus small CWS), and NTNCWS needs. The sampling methodology used by EPA in the DWINSA is explained in Report 1.

Water System Size (population served)	Sampling Methodology	2011 EPA-Estimated needs in 2011\$	2011 EPA-Estimated Needs in 2015\$
>100,000	100% census of systems	\$2,831,300,000	\$2,983,300,000
	<b>Large CWS Total</b>	<b>\$2,831,300,000</b>	<b>\$2,983,300,000</b>
50,001-100,000	60% sample approx.	~\$747,800,000	~\$788,000,000
25,001-50,000	33% sample approx.	~\$1,465,800,000	~\$1,544,500,000
10,001-25,000	33% sample approx.	~\$1,689,000,000	~\$1,779,700,000
3,301-10,000	15% sample approx.	~\$1,137,600,000	~\$1,198,600,000
	<b>Medium CWS Total</b>	<b>\$4,983,400,000</b>	<b>\$5,251,000,000</b>
25-3,300	None. 2007 needs inflated to 2011.	\$1,811,700,000	\$1,909,000,000
	<b>Small CWS Total</b>	<b>\$1,811,700,000</b>	<b>\$1,909,000,000</b>
	<b>20-Year Total CWS Needs</b>	<b>\$9,626,400,000</b>	<b>\$10,143,300,000</b>
	<b>20-Year Total NTNCWS Needs</b>	<b>\$419,400,000</b>	<b>\$441,900,000</b>
	<b>20-Year Total Needs in EPA Report</b>	<b>\$10,045,800,000</b>	<b>\$10,585,200,000</b>

~Not reported in the EPA report; approximated from EPA survey data using number of water systems active in 2015

EPA estimated in 2011 that the 20-year drinking water infrastructure needs in North Carolina of community water systems was \$9,626,400,000 (or a little over \$10 billion if NTNCWS are included). The few large community water systems accounted for \$2.8 billion of this total, while the numerous small community water systems accounted for \$1.8 billion.

Adjusting for CPI-inflation, to 2015 dollars, the total drinking water infrastructure needs estimate for community water systems is \$10,143,300,000<sup>1</sup> (or \$10.6 billion if NTNCWS are included).

The DWINSA uses different sampling techniques for water systems of various sizes, as explained in Report 1. All 13 large systems' infrastructure needs were specifically identified and included in the 2011 survey. There were also 4 other community water systems that were included as "large systems", even though they are, as of July 2015, ranked as "medium systems": (A) Brunswick County; (B) Neuse Regional Water & Sewer Authority; (C) Harnett County; and, (D) Two Rivers Utilities.

Out of the 261 medium systems, 63 were included as a sampled "medium systems", meaning that their infrastructure needs were specifically identified and included in the 2011 survey, and used to extrapolate the needs of the remaining medium systems that were not sampled. Adding the 4 medium systems that were included as "large systems," a total of 67 out of today's 261 (26%) medium systems had their needs data specifically included in the 2011 DWINSA.

None of the 1,750 small community water systems were sampled in 2011. But in 2007, 14 small water systems were included as part of the national sample of small water systems; 6 of which are no longer active water systems in North Carolina.

### **Examples of Differences between 2011 DWINSA Needs Data and the Current CIP Totals for Drinking Water Infrastructure**

As explained in Report 1, the EPA needs surveys only includes the needs estimates for certain types of infrastructure projects; those that are documented, and are eligible for State Revolving Fund loans. In doing so, some of the water systems' infrastructure needs (e.g. needs to expand the treatment plant to accommodate growth) are excluded. Comparing the Capital Improvement Plans of water systems to the needs estimates that were included in the 2011 DWINSA illuminates where the EPA needs estimates may fall short of estimating the actual total infrastructure needs of water systems.

We collected the CIPs of several water utilities between January and March 2016 to make these comparisons. Each CIP was examined, and the drinking water infrastructure needs were separated from wastewater needs or other types of needs. Where CIPs provided a shorter planning period than 20 years, the average annual drinking water infrastructure needs for the final 3 to 5 years in the CIP were used to extrapolate the CIP needs through a 20-year planning horizon. This produced an estimated 20-year total drinking water infrastructure need for the water system, in 2015 dollars, from actual CIPs listing actual infrastructure projects, reflecting a more accurate forecast of the amount of capital that water systems are expecting, or hoping, to spend on infrastructure.

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<sup>1</sup> If using CCI, instead of CPI, to adjust the dollar amounts to 2015 values, the total needs estimate would be \$10,619,700,000.

The differences between the 2011 DWINSA-reported needs (in 2015 dollars) and the 20-year needs estimated by the EFC from the CIPs of water systems are as follows:

PWSID	Water System Name	20-year needs estimated in 2011 DWINSA in 2015\$	20-year needs estimated in more recent CIP in 2015\$	How much higher now?
NC0160010	Charlotte Water	\$560,716,150	\$942,932,560	68%
NC0392010	Raleigh, City Of	\$313,433,939	\$776,355,392	148%
NC0234010	Winston-Salem, City of	\$237,842,589	\$132,739,417	-44%
NC0241010	Greensboro, City of	\$217,426,776	\$456,438,212	110%
NC0332010	Durham, City of	\$190,348,666	\$494,725,309	160%
NC0392020	Cary, Town Of	\$117,532,000	\$308,529,528	163%
NC0465010	CFPUA-WILMINGTON	\$113,802,052	\$162,936,044	43%
NC0136010	Two Rivers Utilities	\$63,739,504	\$96,081,120	51%
NC0464010	Rocky Mount, City Of	\$55,428,414	\$24,186,263	-56%
NC0467010	Jacksonville City Of	\$28,260,951	\$36,464,624	29%
NC0201018	Mebane, Town Of	\$9,460,085	\$6,788,229	-28%
NC0368015	Hillsborough, Town Of	\$17,302,558	\$18,249,460	5%
NC0114040	Sawmills, Town Of	\$4,326,491	\$2,535,989	-41%
NC0416010	Beaufort, Town Of	\$15,775,728	\$13,471,386	-15%

Note: All dollar amounts are in 2015\$. Only drinking water needs are estimated.

The following community water systems were *not* sampled in the 2011 survey, but their recent CIPs were obtained. The drinking water needs estimates are compared with the stratified per-water system averages that were used in 2011 to extrapolate needs of systems not in the sample.

System Size (pop.) category	PWSID	Water System Name	Average 20-year needs as estimated for this size category by 2011 DWINSA in 2015\$	20-year needs estimated in more recent CIP in 2015\$	How much higher now?
50,001-100,000	NC0113010	Concord, City Of	\$78,796,803	\$40,792,362	-48%
50,001-100,000	NC0368010	Orange Water & Sewer Authority	\$78,796,803	\$186,317,386	136%
3,301-10,000	NC4064005	Central Nash Water & Sewer	\$10,575,198	\$17,451,901	65%
501-3,300 Surface	NC7010058	Leland Town Of	\$4,319,000	\$7,799,551	81%
501-3,300 Surface	NC2018004	Southeast Catawba County	\$4,319,000	\$23,646,015	447%
501-3,300 Groundwater	NC0425113	Town of River Bend	\$2,513,410	\$345,298	-86%
101-500 Groundwater	NC0111484	Montreat Water System	\$2,513,410	\$3,363,088	34%
1-500 Surface	NC3099023	Yadkin County Water System	\$1,585,387	\$4,870,470*	207%

\*Yadkin County Water System's needs in the CIP are solely for an "Eastern Water Line". Did not specify years in which the \$5,000,000 would be spent.

Many of the water systems' actual infrastructure needs exceed the amounts estimated for them, or for their system size strata, in the 2011 DWINSA, potentially reflecting needs that are excluded from the needs survey. There are cases, however, where the CIP needs have been adjusted to lower than the DWINSA estimates.



Limitations of this analysis include the lack of accuracy and completeness of information in CIPs, inconsistency across water systems' in CIP planning periods, and using a small number of CIPs to adjust the 2011 DWINSA estimates.

Lack of documentation for small water systems makes it very difficult to check the accuracy of the models used by EPA to estimate their capital needs. Furthermore, the CIPs found for small water systems reveal a lack of comprehensive planning by the water system, including needs for only some types of projects (e.g. distribution line replacement) and excluding needs for other types of projects (e.g. water treatment plant upgrades/rehabilitation).

Most CIPs included detailed cost estimates for 5 years, or in some cases up to 10 years. Accuracy of extrapolating needs to 20 years is therefore likely questionable. Needs estimates for the next 10 years would be more accurate and precise than estimates for 20 years. However, 10-year estimates may exclude large capital needs that are planned for in years 11+ (e.g. a major treatment plant upgrade planned in year 12 would not show up in the 10-year CIP). To allow comparisons against EPA's DWINSA estimates, which were calculated for a 20-year time period, the 20-year estimates of needs were used or extrapolated from the CIP data.

## **How were the Needs Estimates Adjusted from the 2011 DWINSA?**

The 2011 DWINSA needs estimates for community water systems are adjusted in the following steps:

- 1) The number of community water systems was changed from the 2011 survey numbers to the 2,024 active community water systems as of July 2015, to better reflect the current future of infrastructure needs.
- 2) The total needs estimated for each water system size category (stratum) in the 2011 DWINSA was adjusted to account for the new number of water systems in 2015:
  - a. For the large systems, only the needs of the current 13 large systems were included.
  - b. For all other size categories, the average needs per water system in each water system size category (according to the 2011 DWINSA) was multiplied by the current (2015) number of water systems in that category.
- 3) These totals were inflated to 2015 dollars.
- 4) The average difference between the 2011 DWINSA-estimated needs and the more recent CIP-estimated needs within each water system size category was calculated, and then used to adjust the totals in each water system size category.
- 5) The sum of all of the totals by water system size produced the new estimate for active NC community water systems' total drinking water infrastructure needs.

The analysis is displayed in the table on the next page.

Water system size (population served)	Number of community water systems active in July 2015	What the 2011 EPA-estimated needs would have been with current number of systems in 2015\$	Number of assessed water systems (with analyzed CIP needs for comparison)	Average needs of the assessed water systems in 2011 DWINSA in 2015 \$	Average needs assessed from more recent CIPs in 2015\$	% increase (decrease) from 2011 DWINSA to more recent CIP needs estimates	Extrapolated needs in 2015\$
>100,000	13	\$2,531,176,600	7	\$250,157,453	\$467,808,066	87%	\$4,733,400,000
<b>LARGE CWS TOTAL</b>	<b>13</b>	<b>\$2,531,176,600</b>					<b>\$4,733,400,000</b>
50,001-100,000	14	\$1,294,856,484	4	\$69,190,381	\$86,844,283	26%	\$1,625,200,000
25,001-50,000	24	\$882,584,682	1	\$28,260,951	\$36,464,624	29%	\$1,138,800,000
10,001-25,000	83	\$2,166,592,593	2	\$13,381,322	\$12,518,844	-6%	\$2,026,900,000
3,301-10,000	140	\$1,258,573,628	3	\$9,697,343	\$11,153,092	15%	\$1,447,500,000
<b>MEDIUM CWS TOTAL</b>	<b>261</b>	<b>\$5,602,607,387</b>					<b>\$6,238,400,000</b>
501-3,300G	206	\$517,762,380	1	\$2,513,410	\$345,298	-86%	\$71,100,000
501-3,300S	128	\$552,832,010	1	\$4,319,000	\$7,799,551	81%	\$998,300,000
101-500G	658	\$1,121,970,482	1	\$2,513,410	\$3,363,088	34%	\$1,501,300,000
101-500S	92	\$145,855,590	1	\$1,585,387	\$4,870,470	207%	\$448,100,000
1-100G	632	\$289,538,956	0				\$289,500,000
1-100S	34	\$26,047,073	0				\$26,000,000
<b>SMALL CWS TOTAL</b>	<b>1,750</b>	<b>\$2,654,006,491</b>					<b>\$3,334,300,000</b>
<b>TOTAL</b>	<b>2,024</b>	<b>\$10,787,790,477</b>					<b>\$14,306,100,000</b>

## The 20-Year Drinking Water Infrastructure Needs of Active Community Water Systems in NC

Based on the analysis above, we estimate that the 20-year drinking water infrastructure needs of the active community water systems in North Carolina to be within the range of \$10.8 billion to \$15 billion, in 2015 dollars.

## Extrapolating the Centralized Wastewater Capital Infrastructure Needs

In the 2012 CWNS, EPA estimated that the centralized wastewater infrastructure needs for the State of North Carolina was close to \$5.3 billion. Because the CWNS focuses only on certain types of infrastructure needs, the actual total needs for the state’s wastewater systems are higher. This needs estimates is only for centralized wastewater collection/treatment systems owned by local governments. It does not include analysis on stormwater infrastructure needs, decentralized onsite infrastructure needs (e.g. septic systems), or on infrastructure needs of centralized systems not owned by local governments.

### Statistics on North Carolina’s Centralized Wastewater Systems Owned by Local Governments

At the time of publication of this report, to the best of the EFC’s knowledge, there were currently 418 local government units that own active centralized wastewater utilities. The majority of those systems are owned and operated by municipalities.

Municipalities	351
Counties	37
Sanitary Districts	15
Metropolitan Sewerage Districts (includes 1 wholesale only*)	
<ul style="list-style-type: none"> <li>• Seagrove-Ulah Metropolitan Water District</li> <li>• Bay River Metropolitan Sewerage District</li> <li>• Contentnea Metropolitan Sewerage District*</li> <li>• Metropolitan Sewerage District of Buncombe County</li> </ul>	4
Authorities (includes 4 wholesale only*)	
<ul style="list-style-type: none"> <li>• Cabarrus County Water &amp; Sewer Authority*</li> <li>• Cape Fear Public Utility Authority</li> <li>• Lower Cape Fear Water &amp; Sewer Authority*</li> <li>• Martin County Regional Water and Sewer Authority*</li> <li>• Neuse Regional Water &amp; Sewer Authority*</li> <li>• Onslow Water and Sewer Authority</li> <li>• Orange Water &amp; Sewer Authority</li> <li>• South Granville Water and Sewer Authority</li> <li>• Stokes County Water &amp; Sewer Authority</li> <li>• Tuckaseegee Water &amp; Sewer Authority</li> <li>• Yadkin Valley Sewer Authority</li> </ul>	11
<b>Total</b>	<b>418</b>

Note: The 'Counties' figure includes a handful that have very small sewer systems (<100 accounts) and are primarily water-only (e.g. Chatham, Beaufort, Hertford, Burke, Camden, Rockingham, Surry, Warren, etc.)

According to the 2012 CWNS, wastewater from approximately 4.4 million North Carolinians was being collected and treated by 474 facilities. The current total service population is likely higher because of population growth and because these 474 facilities were owned by only 357 out of the 418 local governments with active centralized wastewater systems. It is probable that more than 5 million North Carolinians are currently served by local government centralized wastewater systems. Other centralized wastewater systems, such as those not owned by local governments, serve additional North Carolinians, while many may be on septic systems.

Municipalities and Counties submit data on number of wastewater connections and on volume of wastewater collected and/or treated annually to the Local Government Commission in the AFIR forms. Special units of government (authorities, sanitary districts, etc.) do not report this information to the LGC. For FY2015, the latest available data at the time of this report publication, only 232 municipalities (66% of municipalities with active wastewater systems) reported the number of residential wastewater accounts data in their AFIR forms. The 232 municipalities served a combined 1,228,349 number of residential accounts (more than 3 million people). Likewise, only 24 counties (65% of counties with active wastewater systems) reported the number of residential wastewater accounts data in their AFIR forms, serving a combined 66,358 number of residential accounts. However, these estimates are missing data from several local governments, including Charlotte and Chapel Hill (which is served by OWASA), so the total number of connections and people served is underreported in the AFIR data. It also excludes the population served by local government units that are not municipalities or counties<sup>2</sup>.

### Statistics on the Wastewater Needs Data from the 2012 CWNS

The EPA reported that North Carolina had \$5,296,000,000 in wastewater infrastructure needs in 2012 (or \$5,467,000,000 in 2015 CPI-adjusted dollars), excluding needs of decentralized (onsite) systems.

This is down from \$7,669,000,000 (in 2015 dollars) reported by EPA in the 2008 CWNS. Stormwater infrastructure needs were included in the 2008 CWNS, but not in the 2012 CWNS. The largest decrease, however, occurred in estimates for needs of new conveyance wastewater systems.

Category of Need	In EPA's 2012 Report to Congress (2012\$)	In EPA's 2008 Report to Congress (2012\$)	Change from 2008 to 2012
Secondary Wastewater Treatment (I)	\$257,000,000	\$213,000,000	21%
Advanced Wastewater Treatment (II)	\$2,134,000,000	\$2,671,000,000	-20%
Conveyance System Repair (III)	\$746,000,000	\$1,023,000,000	-27%
New Conveyance Systems (IV)	\$1,942,000,000	\$3,141,000,000	-38%
Combined Sewer Overflow Correction (V)	\$1,000,000	\$4,000,000	-75%
Stormwater Management Program (VI)	not reported	\$99,000,000	not in 2012
Recycled Water Distribution (X)	\$216,000,000	\$278,000,000	-22%
<b>Total</b>	<b>\$5,296,000,000</b>	<b>\$7,429,000,000</b>	<b>-29%</b>
<i>Total in 2015\$</i>	<i>\$5,467,000,000</i>	<i>\$7,669,000,000</i>	<i>-29%</i>

<sup>2</sup> Mapping each of the 418 utilities with one Census Place (primary service area but certainly not a complete and accurate representation of the service population), the total Census population is 10,030,000. This exceeds the State's total population of 9,750,405 because several Census Places are double-counted by being assigned to more than one utility.

In the 2012 CWNS, the 10 local governments with the largest wastewater needs were (in 2012 dollars):

- Raleigh: \$888,000,000
- Charlotte Water: \$628,000,000
- Pender County: \$429,000,000
- Cape Fear Public Utility Authority: \$399,000,000
- Cary: \$263,000,000
- Greenville Utilities Commission: \$259,000,000
- Durham: \$210,000,000
- Jacksonville: \$114,000,000
- Metropolitan Sewerage District of Buncombe County: \$111,000,000
- Shelby: \$99,000,000

The \$5.3 billion in infrastructure needs were calculated for 306 facilities statewide, which were owned by at least 264 units of local government. Some of these units of local government are currently inactive, or their wastewater systems were since consolidated under other local governments' control since the 2012 CWNS.

Details of how the CWNS was conducted, as well as its limitations in estimating the actual total needs of the state are described in Report 1. In particular, the CWNS needs estimate for the State of North Carolina is low for two main reasons:

1. It does not include the needs of all local government wastewater systems, and
2. It does not include the full cost of all capital projects even for the local governments that were included in the survey.

### Incomplete Census of Infrastructure Needs

Although the CWNS is a census of wastewater infrastructure needs in the state, it is not a complete census. Out of 418 currently-active local government utilities, 230 (55%) have non-zero capital needs in the 2012 CWNS, accounting for \$5.022 billion of needs (\$5.184 billion in 2015\$). The 188 "excluded utilities" are: (A) 149 municipalities; (B) 20 counties; and, (C) 19 special units of local governments. A small number of these local governments were actually surveyed by the State in 2012, but EPA excluded their capital needs estimates from the final analysis.

Using the Census Population of a single/primary Census Place<sup>3</sup> per local government utility as a relative indicator of system size, we estimate that the 188 excluded local governments serve less than 35% of the population that is served by the 418 active local government utilities. The median Census Place population for "included utilities" is 3,440, compared to the median of 2,013 for the "excluded utilities".

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<sup>3</sup> This may be a good approximation for municipalities if the utility serves nearly the entire municipal population, but it is likely a poor approximation for counties and special units of government that serve portions of counties and cannot be adequately approximated using a single Census Place.

Thus, there are proportionally more small local governments excluded from the 2012 CWNS estimates than larger local governments.

### Incomplete Assessment of Infrastructure Needs

The wastewater infrastructure needs estimates in the official EPA 2012 CWNS documents are too low, even for the wastewater utilities that were included in the survey.

When the State surveyed the needs of wastewater systems in 2012, the State created a more comprehensive list of needs, totaling \$6,163,000,000 (or \$6,362,000,000 in 2015\$) within the survey’s needs categories. However, in their review, EPA determined which capital projects, and what portion of the capital needs, is eligible to be included in the official needs survey estimates. EPA distinguished between “unofficial” and “official” needs, and adjusted the “official” needs (on average: down) from the documented base amount. As a result, the final official estimates of needs in North Carolina was lower than the actual needs that the State identified for the systems that were included in the survey, as shown in the table below.

Category of Need	Reported by NC DWI to EPA	In EPA's 2012 Report to Congress in 2012\$	Change in Estimate by EPA	% Change
Secondary Wastewater Treatment (I)	\$336,000,000	\$257,000,000	-\$79,000,000	-24%
Advanced Wastewater Treatment (II)	\$2,452,000,000	\$2,134,000,000	-\$318,000,000	-13%
Conveyance System Repair (III)	\$904,000,000	\$746,000,000	-\$158,000,000	-17%
New Conveyance Systems (IV)	\$2,235,000,000	\$1,942,000,000	-\$293,000,000	-13%
Combined Sewer Overflow Correction (V)	\$3,000,000	\$1,000,000	-\$2,000,000	-67%
Stormwater Management Program (VI)	not reported	not reported		
Recycled Water Distribution (X)	\$233,000,000	\$216,000,000	-\$17,000,000	-7%
<b>Total</b>	<b>\$6,163,000,000</b>	<b>\$5,296,000,000</b>	<b>-\$867,000,000</b>	<b>-14%</b>
<i>Total in 2015\$</i>	<i>\$6,362,000,000</i>	<i>\$5,467,000,000</i>	<i>-\$895,000,000</i>	<i>-14%</i>

Using the State’s own estimates of infrastructure needs for the systems that were surveyed in 2012, total infrastructure needs were \$6,362,000,000 in 2015 dollars; 14% higher than the official estimate reported by EPA.

### Examples of Differences between 2012 CWNS Needs Data and the Current CIP Totals for Wastewater Infrastructure

However, there are also differences between the State-determined (and EPA-determined) needs estimates from 2012 and more recent needs estimates that can be derived from recent CIPs. Using the CIPs collected between January and March 2016, each CIP was examined and the wastewater infrastructure needs were identified. Where CIPs provided a shorter planning period than 20 years, the average annual infrastructure needs for the final 3 to 5 years in the CIP were used to extrapolate the CIP needs through a 20-year planning horizon. This produced an estimated 20-year total wastewater infrastructure need for the system, in 2015 dollars, from actual CIPs listing actual infrastructure projects.

Examples of the differences between the 2012 CWNS-reported needs (in 2015 dollars) and the 20-year needs estimated by the EFC from the CIPs of wastewater systems are as follows:

Local Government Wastewater Utility	Official needs reported by EPA in 2012 CWNS in 2015\$	Needs estimated by the State for the 2012 CWNS in 2015\$	20-year needs estimated in more recent CIP in 2015\$	How much higher now from EPA estimate?	How much higher now from State estimate?
Raleigh	\$917,145,439	\$929,872,189	\$1,272,309,838	39%	37%
Charlotte Water	\$648,327,979	\$670,013,904	\$1,261,810,541	95%	88%
Winston-Salem	\$72,187,267	\$87,215,400	\$573,502,840	694%	558%
Cape Fear PUA	\$411,709,642	\$411,709,642	\$343,761,874	-17%	-17%
Durham	\$217,270,965	\$217,270,965	\$280,826,379	29%	29%
Cary	\$271,019,100	\$294,799,521	\$245,024,056	-10%	-17%
OWASA	\$39,184,990	\$39,184,990	\$224,537,580	473%	473%
Greensboro	\$97,815,929	\$104,456,961	\$171,276,299	75%	64%
Jacksonville	\$117,219,703	\$117,219,703	\$122,625,906	5%	5%
Mebane	\$6,591,386	\$11,403,782	\$29,193,437	343%	156%
Hillsborough	\$36,837,460	\$36,837,460	\$21,599,442	-41%	-41%
Two Rivers Utility	\$90,870,646	\$90,870,646	\$20,012,180	-78%	-78%
River Bend	\$3,196,958	\$5,531,068	\$361,975	-89%	-93%
<b>Total</b>	<b>\$2,929,377,464</b>	<b>\$3,016,386,231</b>	<b>\$4,566,842,347</b>	<b>56%</b>	<b>51%</b>

All dollar amounts are in 2015\$. Only centralized wastewater and reclaim water needs are estimated.

In some cases, the difference between 2012 CWNS needs estimates and the more recent CIP estimates are likely due to updated infrastructure planning and construction projects. In the cases of significant decreases (e.g. Two Rivers Utility, River Bend), other documents were used in 2012 to estimate needs that were not included in their CIPs. Better documentation of needs in CIPs may have accounted for significant increases in other cases, as well as differences in the planning horizon. The CWNS does not *require* calculating needs using a 20-year horizon; instead, needs for wastewater utilities can be included if they are expected to be paid within 20 years and are documented. For some utilities that only publish a 5-year CIP, only 5 years of needs are included in the survey, compared to another utility that publishes 10 years or 20 years of needs. In the table above, it appears that OWASA's 5-year CIP was used to calculate its \$39 million in needs, although OWASA's internal 15-year CIP spreadsheet (what we used to determine OWASA's wastewater infrastructure needs) could be used to determine its 15 years of needs accurately, or extrapolate to 20 years of needs as shown in the table above.

The following wastewater systems were *not* included in the 2012 survey, but their recent CIPs were obtained. These examples demonstrate one of the limitations of using an incomplete census (instead of a statistical sampling survey) to calculate needs for the state. Because these five utilities (among others) were excluded from the survey, their \$18 million in infrastructure needs were not recognized in the CWNS totals. An examination of using statistical sampling, instead of a census, approach to the CWNS is described in Report 3.

Local Government Wastewater Utility	20-year needs estimated in more recent CIP in 2015\$
Concord	\$6,817,829
Nash County	\$4,457,259
Beaufort	\$2,382,321
Sawmills	\$2,121,212
Yadkin County	\$2,451,390



## How were the Needs Estimates Adjusted from the 2012 CWNS?

Because the differences between the recent CIP-derived needs and 2012 CWNS needs estimates vary significantly from one utility to the next, without a consistent trend based on system size, and needs estimates planning periods may not be consistent across utilities, it would be very difficult and imprecise to adjust the 2012 CWNS estimates based on 20-year projections of needs from current CIPs. It appears that each utility's needs estimate would need to be adjusted on a case-by-case basis, rather than applying an average adjustment factor statewide based on system size or type, such as the methodology used in estimating drinking water infrastructure needs. In effect, this is precisely the process the State currently undertakes every four years when it conducts a new CWNS for EPA; the State collects the most recent CIP data from wastewater utilities and transcribes the latest information to update the survey.

Instead, inaccuracies in the reported 2012 needs estimates for surveyed utilities should be corrected in other means. The simplest process would be to revert to the State-derived needs estimates, prior to the EPA adjustments and exclusions. EPA reduced the 20-year needs projection for the surveyed 311 facilities from \$6,163,000,000 to \$5,296,000,000 partially to maintain consistency in its assessments of all infrastructure needs nationwide. However, for a state-specific assessment of needs, the State-derived needs estimates are more accurate because they are more inclusive of all types of needs and are determined using local costs.

The second step would be to extrapolate the infrastructure needs estimate to a specific and consistent timeframe for all wastewater facilities. This could be 20 years, to match the DWINSA assessment, or 10 years to better match CIPs, which are more commonly between 5 and 10 years. Projections beyond 10 years increase the uncertainty in the needs estimates substantially. This step could be accomplished easily in the future when, for the next CWNS, the State notes the duration of each CIP or needs documentation and the annual estimated needs for each system. However, without access to this information from the 2012 CWNS, it would not be possible to simply and quickly implement this step to adjust the 2012 CWNS needs numbers.

Importantly, the 2012 CWNS needs estimates must be extrapolated to account for the needs of wastewater systems that were not included in the survey in 2012. This can be accomplished in several methods, including using statistical sampling techniques, as described in Report 3. The simplest method, however, is to calculate an average wastewater needs estimate (using the State-derived needs estimates) for different strata of active wastewater utilities, and extrapolating those needs on the excluded wastewater utilities that are currently active. This is similar to the method used in the DWINSA, and essentially extends the census-style CWNS into a hybrid census and stratified survey. Unlike statistically-representative surveys, though, this method does not involve intentionally sampling local governments and using weights to analyze data (which is the method that is explored in Report 3). For this report, however, the focus of the analysis is to use the existing data from the 2012 CWNS to roughly estimate current wastewater needs, filling in the gaps left behind by the CWNS.



With incomplete service population data, we cannot accurately stratify the utilities based on system size. However, the Census Place population can be used as a rough surrogate for system size by creating three strata that place each local government unit in an appropriate stratum, even if the precise population number is inaccurate. The 230 utilities included in the survey are as equally spread out across the following three population-based strata as the 188 utilities excluded from the survey.

Population Size Group of Assigned Census Place	Local government wastewater utilities			
	Included in the 2012 CWNS survey	%	Excluded from the 2012 CWNS	%
1-5,000	143	62%	116	62%
5,001-20,000	38	17%	32	17%
>20,000	49	21%	40	21%
<b>Total</b>	<b>230</b>	<b>100%</b>	<b>188</b>	<b>100%</b>

It would be ideal to create more strata based on types of facilities (e.g. collection system only vs. collection system and treatment plant), but that information is not readily available for all currently-active local governments.

Next, the State-derived infrastructure needs for only the currently-active wastewater systems are used to calculate a median needs estimate for each of the strata. The 230 currently-active wastewater systems in the survey accounted for \$5,781,000,000 needs in 2012 (or \$5,968,000,000 in 2015 dollars). The median is preferred over the average because the largest utilities are already included in the survey and would skew the average upwards, while the excluded utilities are closer in size to the smaller utilities within each stratum. The median needs estimate is multiplied by the number of utilities excluded from the survey (188 across the 3 strata) to extrapolate needs for this missing group (~\$1.4 billion), which is then added to the total needs of the included utilities.

Population Size Group of Assigned Census Place	Utilities included in the 2012 CWNS survey	Total State-Derived Infrastructure Needs in 2015\$	Median Needs Per Included Utility	Utilities excluded from the 2012 CWNS survey	Extrapolated Needs of Excluded Utilities in 2015\$	Total Needs in 2015\$
1-5,000	143	\$561,044,782	\$2,255,660	116	\$261,656,527	\$823,000,000
5,001-20,000	38	\$624,706,170	\$8,793,752	32	\$281,400,064	\$906,000,000
>20,000	49	\$4,782,016,902	\$21,435,572	40	\$857,422,898	\$5,639,000,000
<b>Total</b>	<b>230</b>	<b>\$5,967,767,854</b>		<b>188</b>	<b>\$1,400,479,489</b>	<b>\$7,368,000,000</b>

The total estimated wastewater infrastructure needs, in 2015 dollars, based solely on the needs data determined by the State for the 2012 CWNS, is about \$7,368,000,000, which is 35% higher than the official 2012 CWNS needs estimate for the State of North Carolina.

However, this is not specifically a 20-year needs estimate, since the needs were sometimes calculated using shorter CIPs and documents. In the table comparing 2012 CWNS needs estimates with 20-year projections of recent CIPs of individual utilities, it was estimated that the 20-year projections from

recent CIPs would increase the State-derived needs estimate by 51%. If this applies across the entire state, then the extrapolated wastewater infrastructure needs may increase by approximately 50%. Applying this 50% correction factor to the \$7.4 billion estimate above, the total infrastructure needs estimate could reach \$11.1 billion. Since the actual correction factor is unknown, but the 50% above was skewed by very large changes in the estimates for Winston-Salem and OWASA, the correction factor might be lower than 50% when all wastewater systems, especially the smaller ones, are accounted for.

## The 20-Year Infrastructure Needs of Centralized Wastewater Systems Owned by Local Governments in NC

Based on the analysis above, we estimate that the 20-year infrastructure needs of the 418 active centralized wastewater systems owned by local governments in North Carolina to be **within the range of \$7.4 billion to \$11.1 billion, in 2015 dollars**. When the infrastructure needs of other wastewater systems – decentralized, or owned by private entities – are included, the total needs estimates would rise.

## Conclusion

The EPA needs surveys – the DWINSA and the CWNS – focus on estimating national and statewide infrastructure needs of water and wastewater systems for projects that are eligible for State Revolving Fund loans. By comparing the system-level needs estimates in these surveys against more recent CIP data that are more inclusive of all types of infrastructure projects, and by extrapolating needs to current numbers of active systems statewide, we could adjust the EPA needs estimates for the state to provide more accurate ranges of total infrastructure needs. This methodology requires obtaining the system-level needs data from the DWINSA and CWNS, as well as several CIPs from water and wastewater systems of different sizes for comparison.

This methodology can be replicated after each iteration of the EPA needs surveys, and is the one described as Option 2 in the list of alternative methods that the State of North Carolina can employ to assess the infrastructure needs of the state for planning purposes (see Report 6).

We estimate that the total 20-year infrastructure needs for the state are likely to be in the range of **\$10.8 billion - \$15 billion for drinking water systems** (active community water systems) and **\$7.4 billion - \$11.1 billion for wastewater systems** (active centralized wastewater systems owned by local governments). We therefore estimate that the **combined 20-year water and wastewater infrastructure needs in the State of North Carolina are in the range of \$18.2 billion – \$26.1 billion**. These estimates may be lower than actual needs, however, because they were derived by extrapolating from the EPA needs survey estimates that are, by design, narrower in scope than a comprehensive assessment of all infrastructure needs in the state (see Report 1). Furthermore, they exclude the infrastructure needs of decentralized wastewater systems as well as centralized wastewater systems that are not owned by local governments.