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CHEROKEE NATION®

The Wilma P. Mankiller and Charlie Soap Water Act

Biennial Report 2024

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EXECUTIVE SUMMARY

Seated L-R: Cherokee Nation Deputy Chief Bryan Warner, Principal Chief Chuck Hoskin Jr., and former Executive Director of Community Service Charlie Soap. (April 14, 2021)

The Wilma P. Mankiller and Charlie Soap Water Act (MSWA) was passed by the Council of the Cherokee Nation and signed into law by Principal Chief Chuck Hoskin Jr. and Deputy Principal Chief Bryan Warner on April 14, 2021. This biennial report will provide a summary of the activities completed during the 2022-2024 period, update the three primary deliverables of the MSWA, and provide a forecast of future environmental and regulatory burdens which will impact the water systems serving the Cherokee Nation.

This biennial report encompasses the three primary objectives of the Mankiller/Soap Water Act:

1. To conduct a census of Cherokee citizens who lack access to water systems utilizing all available forms of information and public outreach, and develop a plan of action to provide access to water to each Cherokee citizen identified in the census.
2. Identify the number of Cherokee citizens per county within the Cherokee Nation Reservation, whose access is limited to well water supply and develop long-term strategies to bring rural water supply to as many such citizens as is practical.
3. Identify the most infrastructure deficient public water systems within the Cherokee Nation Reservation.

Each of these objectives presents unique challenges in relation to the data required, methods utilized, and resources needed to provide a truly comprehensive and accurate report. There are approximately 121 small public water systems and 53 small public wastewater systems across the nearly 7,000 square miles of the Cherokee Nation Reservation. Approximately 150,000 Cherokee citizens are also continually moving in and out of the reservation, as well as moving around inside the reservation boundaries. Each of the systems were evaluated on both their technical, managerial, and financial (TMF) capacity as well as a thorough evaluation of the systems infrastructure.

We consider this as the first time a comprehensive and proactive evaluation has been attempted across the spectrum of small public water and wastewater systems by any governmental or non-governmental organization. This information will drive the decision making on how to best to apply future MSWA funding as well as identify opportunities to leverage MSWA funding to obtain additional federal, state and philanthropic resources for communities inside the Cherokee Nation Reservation.

Each of the three objectives dictated in the law are detailed in the following sections of this report.

TASK ONE

CENSUS OF HOMES INSIDE THE CHEROKEE NATION RESERVATION AND WATER ACCESS

FIRST OBJECTIVE

The first objective of the MSWA is to: "conduct a census of Cherokee citizens who lack access to water systems utilizing all available forms of information and public outreach, and develop a plan of action to provide access to water to each Cherokee citizen identified in the census."
(MSWA LA 15-21 § 3 A)

METHODOLOGY

An online survey was conducted over two periods. The most recent survey resulted in 1,900 responses and those responses are dictated throughout this report.

RESULTS OF CENSUS

To comply with the directives of the Mankiller/Soap Water Act; "respecting the privacy interest of individual Cherokee citizens," the Gadugi Portal survey only captured the name and contact information of each citizen that expressly consented to be contacted via their email address.

Does your home currently have a water supply that works for your daily needs?

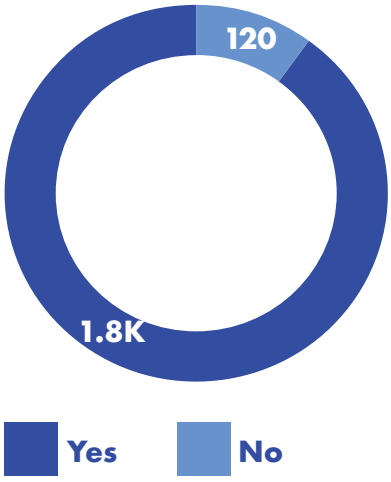


Figure 2.1 Does your home have a water supply that works for your daily needs?

Does your home currently have a working wastewater system?

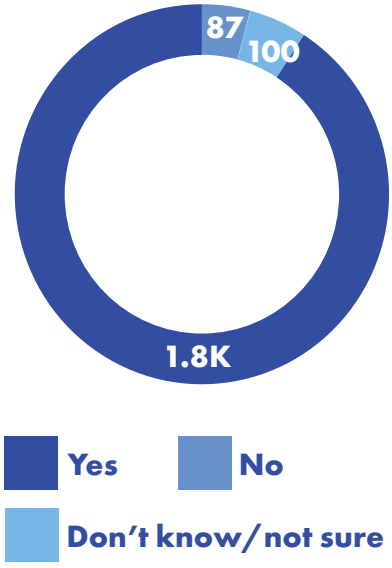


Figure 2.2 Does your home currently have a working wastewater system?

Do you consent to being contacted by email?

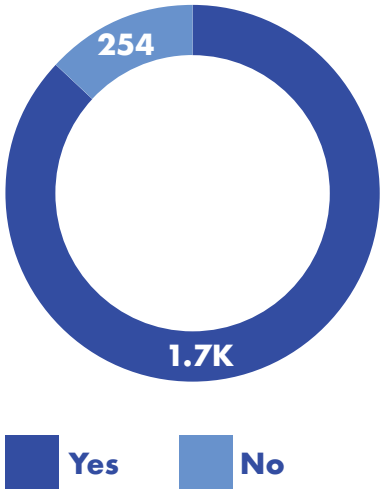


Figure 2.3 Respondents who agreed to be contacted by email.

Out of the over 1,900 survey responses, a total of 120 respondents living inside the Cherokee Nation Reservation self-reported that their homes water supply did not meet their daily needs. *(Figure 2.1)* This equates to approximately 6.1% of the respondents. While the number of total responses decreased from 2022 to 2024 the number of responses indicating issues with water supplies and wastewater systems remained very consistent with 205 reporting issues in 2022 and 207 reporting issues in 2024.

Survey participants were also asked to report if their home currently has a working wastewater (septic/sewer) system. (Figure 2.2) Of the 1,947 responses, 87 respondents (4.4%) answered "no" with an additional 100 respondents (5.1%) answering "don't know/not sure."

One major requirement of the MSWA is to respect the privacy of the survey respondents. In order to achieve that the respondents were required to "opt-in" to be contacted by the Department of Transportation and Infrastructure via email. Of the 1,947 surveys, 254 (13%) indicated they did not want to be contacted. *(Figure 2.3)*

Of the 120 respondents who indicated that their water system was not adequate for their daily needs, 116 gave permission to contact them via email. Of the 87 respondents who indicated that they did not have an adequately functioning septic system, 76 gave permission to contact via email. In total 186 of the 207 responses (89.9%) gave permission to be contacted. This was a large improvement over the 2022 survey where only 8% of the respondents gave permission to contact them.

TASK TWO

HOMES IN CHEROKEE NATION RESERVATION WITHOUT ACCESS TO A PUBLIC WATER SUPPLY

SECOND OBJECTIVE

The second task under the requirements of the Mankiller/ Soap Water Act is to: "Identify the number of Cherokee citizens, per county within the Cherokee Nation Reservation, whose access to water is limited to a well water supply and develop long-term strategies to bring rural water supply to as many such citizens as is practical."

(MSWA LA 15-21 § 3 A)

METHODOLOGY

In order to provide an accurate and comprehensive report for this task, two datasets are needed. First, a comprehensive GIS dataset for Cherokee homes is needed to establish the geographic locations of each home. Second, a comprehensive GIS dataset for public water systems across the Cherokee Nation Reservation is needed to establish which homes lie outside the service areas of those water systems.

DATASETS

The Oklahoma Water Resources Board (OWRB 2012) developed a state-wide GIS data set for public water systems (PWS). This is the only publicly available PWS data and it has many errors, omissions, and inconsistencies. As part of the data gathering efforts of the MSWA the Department of Transportation and Infrastructure is prioritizing the collection of current, accurate PWS GIS data. Since 2022 significant GIS mapping projects were initiated or completed for several towns and water systems. These projects included: Town of Westville, Town of Watts, Chelsea Economic Authority, Ironside Water Corporation, Town of Copan, Town of Lenapah, Town of Delaware, Town of Gore, Nowata County RWD No.3, Nowata County RWD No. 5, and the Town of Adair. Utilizing the Diamond Maps application the Department of Transportation and Infrastructure now has access to 26 public water and wastewater systems GIS data.

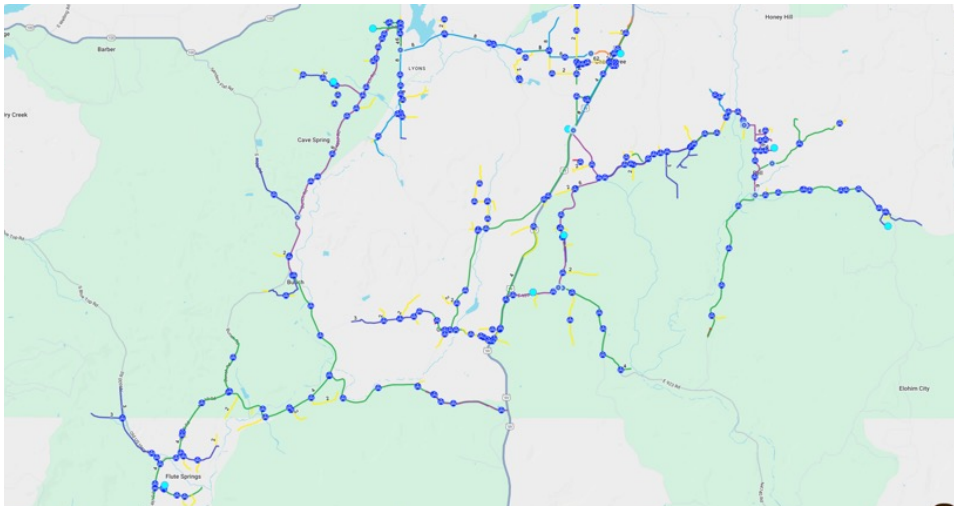


Figure 2.4 Example of Diamond Maps Geographic Information Systems (GIS) data set for the Cherry Tree RWD

ANALYSIS

ArcGIS Pro software was utilized to examine the above GIS datasets and determine which homes lie outside of the public water system service areas. The results are as follows:

County	Total Homes	Outside PWS	% of Total
Adair	5,372	811	10.1%
Cherokee	8,055	2,155	26.8%
Craig	1,551	169	2.1%
Delaware	5,423	2,584	32.1%
Mayes	4,347	629	7.8%
McIntosh	107	12	0.1%
Muskogee	2,437	490	6.1%
Nowata	890	45	0.6%
Ottawa	694	365	4.5%
Rogers	5,161	128	1.6%
Sequoyah	3,999	146	1.8%
Tulsa	4,032	224	2.8%
Wagoner	883	59	0.7%
Washington	2,273	237	2.9%
Total	**45,224**	**8,054**	**100.0%**

FUTURE PROJECT IDENTIFICATION AND DEVELOPMENT

The second requirement of Task 2 is to: "develop long-term strategies to bring rural water supply to as many such citizens as is practical."

The department will work with external engineering partners to perform feasibility studies in the large areas of the Cherokee Nation Reservation that currently lack access to a public water supply to determine which areas can economically and realistically be served. Funding from the Mankiller/Soap Water Act will be utilized to perform these studies. Should new public water systems need to be established, funding from the MSWA may be required to help accomplish the legal and organizational work necessary. Projects that are found to be feasible will have engineering reports prepared and included in the Indian Health Service Sanitation Deficiency System (SDS) list for funding consideration (Appendix A). Funding from the MSWA may be needed to provide these engineering reports as well as provide matching funds, or to cover project expenses that IHS considers ineligible.

TRIBAL HOMES OUTSIDE PUBLIC WATER SYSTEM BOUNDARY, CHEROKEE NATION RESERVATION

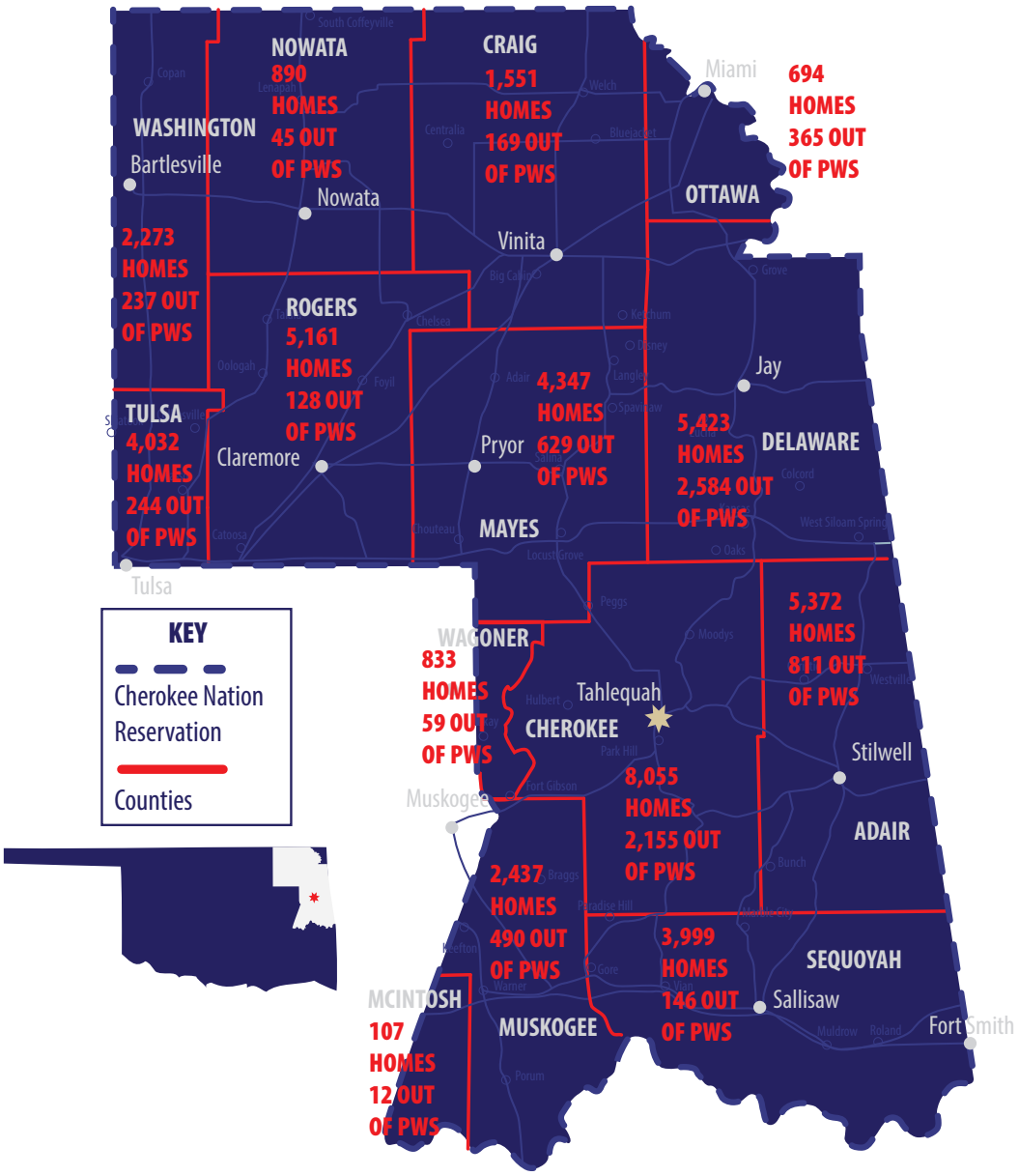


Figure 4.1 Homes lying outside the service areas of OWRB PWS Boundaries

TASK THREE

IDENTIFICATION OF THE MOST INFRASTRUCTURE DEFICIENT PUBLIC WATER SYSTEMS

THIRD OBJECTIVE

The third task of the Mankiller/Soap Water Act is to determine infrastructure deficiencies of the 121 small public water systems and 53 public sewer systems within the Cherokee Nation Reservation. Each of these public water and sewer systems vary in size, scope, age, and capacity. There is also a wide disparity in the technical, managerial and financial (TMF) capacity of each organization. Utilizing the MSWA to evaluate each public water/sewer system, assessing not only the physical infrastructure but their TMF capacity will help develop a comprehensive and holistic picture of the public water infrastructure within the Cherokee Nation Reservation. Some funds exist through the tribe and other partners, the ownership of the infrastructure remains with the utility organization. The ability to properly operate and manage the infrastructure remains a disparity. Future plans, should include training and resources for municipalities and rural water operators.

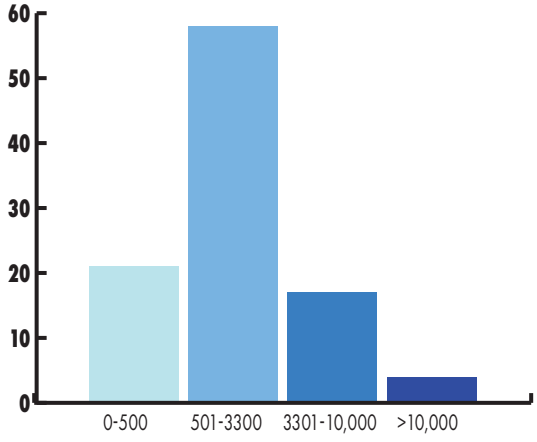
METHODOLOGY

A partnership was developed with the Oklahoma Rural Water Association to perform the site visits, evaluate the TMF capacity and physical infrastructure of each water system and report the results back to the Cherokee Nation. Initial meetings focused on developing the evaluation process, determining the information to be collected and selecting which public water systems would be involved in the initial data gathering. A comprehensive capacity development survey was utilized to measure the TMF capacity of each utility. The Indian Health Service standard deficiency listing was utilized for consistency, and to ensure that the identified physical infrastructure needs would be eligible for inclusion in the IHS SDS annual submittal.

SYSTEM EVALUATIONS

Since the beginning of the MSWA, 121 public water systems *(Figure 4.2)* and 53 public sewer systems *(Figure 4.3)* have been evaluated for both their TMF capacity and their infrastructure need. Of the systems that were evaluated over 70% of them are considered "very small" by the US EPA, serving populations of less than 3,300.

WATER SYSTEM SIZE AND FREQUENCY

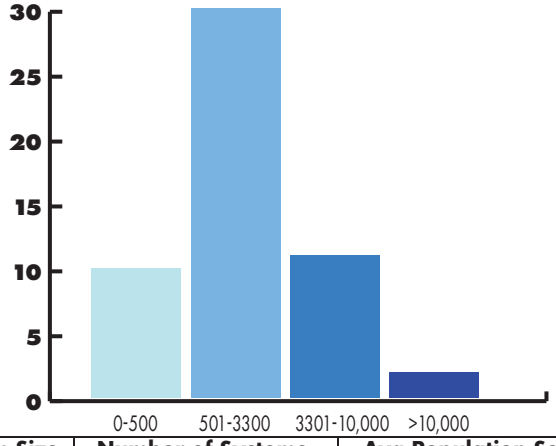


System Size	Number of Systems	Avg Population Served
0-500	25	325
501-3,300	70	1525
3,301-10,000	21	5044
>10,000	5	15592

Figure 4.2 Size and frequency of small public water systems across the Cherokee Nation Reservation.

95 OF 121 (78.5%) SERVE POPULATIONS LESS THAN 3,300

WATERWASTE SYSTEM SIZE AND FREQUENCY



System Size	Number of Systems	Avg Population Served
0-500	10	355
501-3,300	30	1491
3,301-10,000	11	5606
>10,000	2	15166

Figure 4.3 Size and frequency of small public wastewater systems across the Cherokee Nation Reservation.

40 OF 53 (75.5%) SERVE POPULATIONS LESS THAN 3,300

EVALUATION RESULTS

Tables of the evaluation results are included in this report as Appendix B. These tables are separated into water and wastewater utilities for convenience and ease of reference. The summary scores are included in the table along with the top three priorities identified by the utility and system evaluator along with proposed solutions. The survey forms are kept on file with the Department of Transportation and Infrastructure and are available upon request.

In looking at the water capacity development scores on a scale of 0-100 the average score was 73.34 and ranged from 33.0-96.0 *(Figure 4.5)*. Transposing this to an A-F grade scale, the mean value is a C with 46 of the systems scoring a D or less. Twenty-five water systems received the equivalent of an F rating. Before beginning the evaluation process, we hypothesized that the smaller systems would have lower capacity development scores and that the scores would improve as system size increased due to larger budgets, more stable management and internal capacity. That hypothesis was generally supported as the average scores tended to increase as the size of the system increased however we found our lowest score in the 500-3,300 population classification and noticed a small decrease in average capacity development when moving from the 3,300 – 10,000 classification to the over 10,000 classification. Since the initial MSWA report the average scores did improve slightly, but it is clear that there is a lot of opportunity to assist public water systems with their TMF capacity.

PUBLIC WATER SYSTEM, CAPACITY DEVELOPMENT COUNTY-WIDE SCORE CHEROKEE NATION RESERVATION

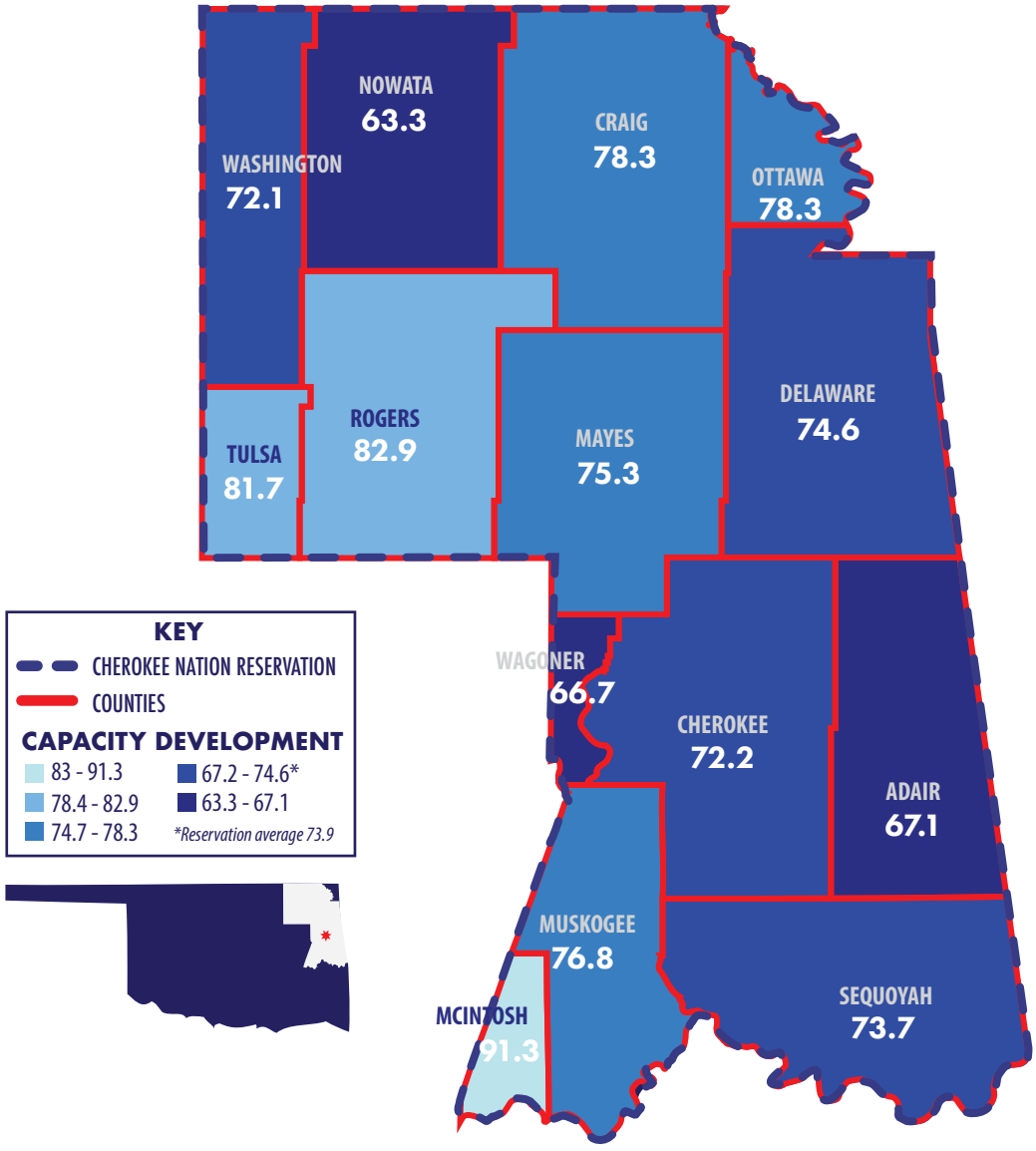
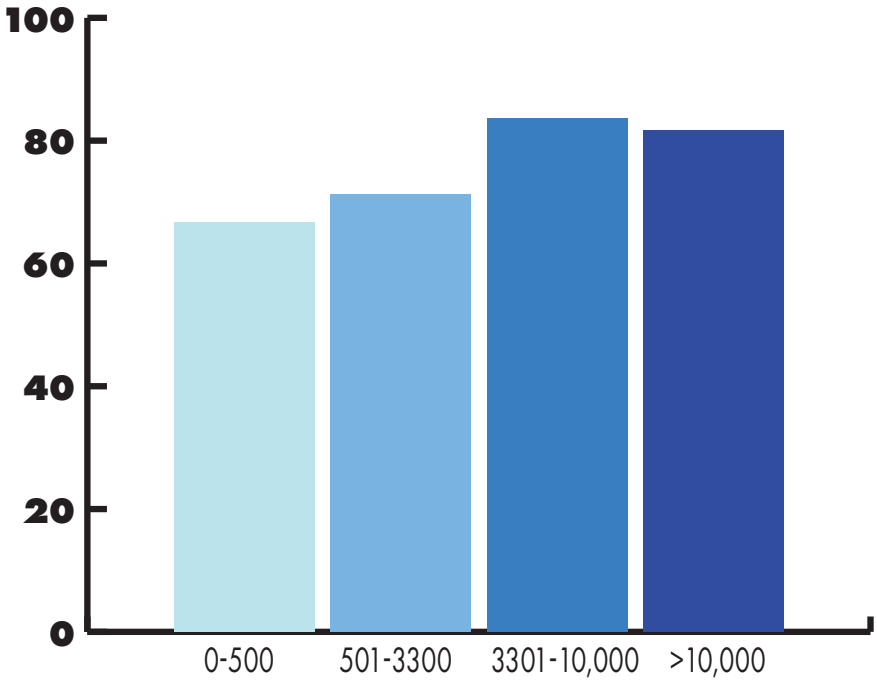


Figure 4.4 Average countywide capacity development scores for small public water systems. Lower scores indicate less capacity for the system to be sustainable in the long term.

WATER CAPACITY DEVELOPMENT



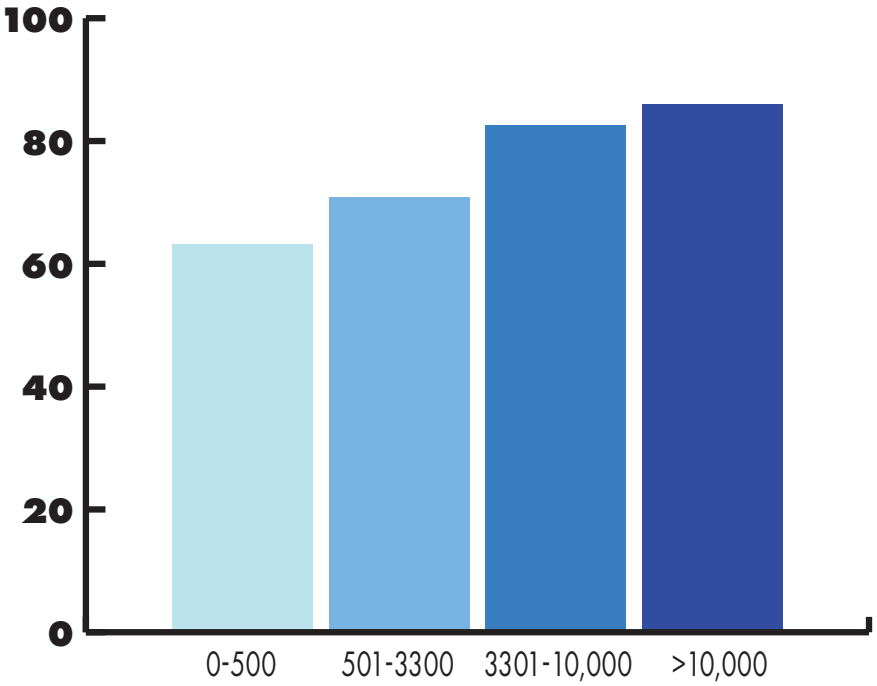
System Size	Max Score	Min Score
0-500	89	38.5
501-3,300	96	33
3,301-10,000	95	59.6
>10,000	93	69.7

System Size	Avg Cap Dev Score
0-500	66.64
501-3,300	71.30
3,301-10,000	83.68
>10,000	81.64

Figure 4.5 Average capacity development scores for small public water systems sorted by system size.

WASTEWATER CAPACITY DEVELOPMENT

Wastewater capacity development scores *(Figure 4.6)* tended to follow the expected trend with larger systems having higher average score, however just as with the water capacity development scoring the lowest scoring system occurred in the 501-3,300 classification.



System Size	Max Score	Min Score
0-500	89	45
501-3,300	96	33
3,301-10,000	95	71
>10,000	93	80

System Size	Max Score	Min Score
0-500	89	45
501-3,300	96	33
3,301-10,000	95	71
>10,000	93	80

Figure 4.6 Average capacity development scores for small public wastewater systems sorted by system size.

PUBLIC SEWER SYSTEM, CAPACITY DEVELOPMENT COUNTY WIDE SCORE, CHEROKEE NATION RESERVATION

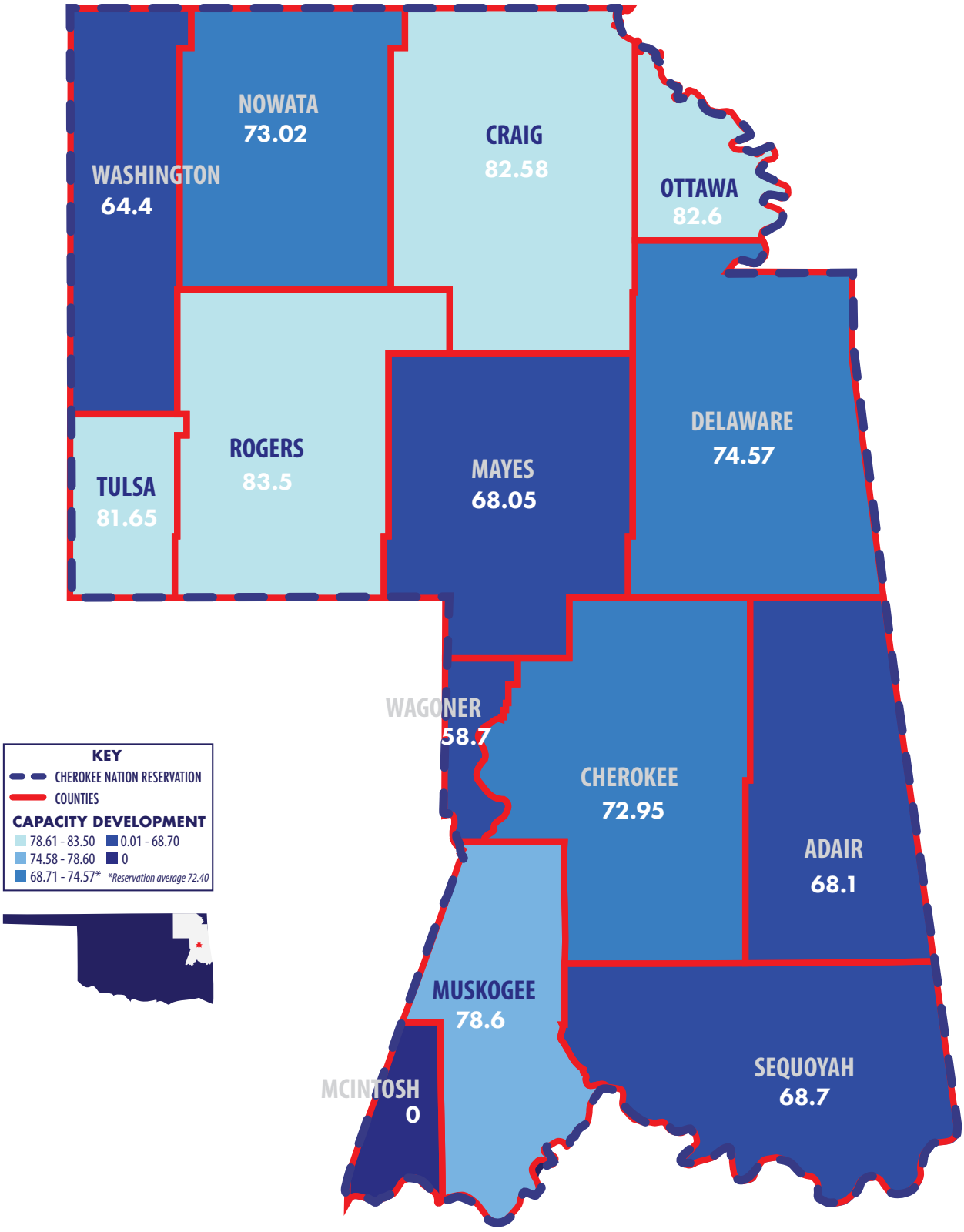
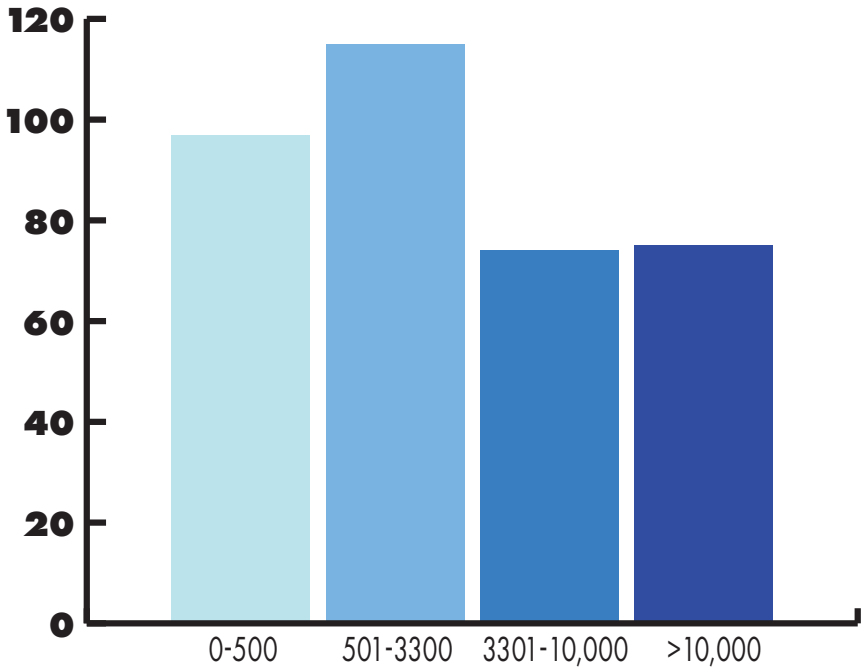


Figure 4.7 Average countywide capacity development scores for small public sewer systems. Lower scores indicate less capacity for the system to be sustainable in the long term.

WATER INFRASTRUCTURE NEED SCORE

The water infrastructure scores ranged from 0-315 with higher values indicating more needs with higher public health priorities *(Figure 4.8)*. The maximum possible score is 375. The mean value for water infrastructure need was 101.27.



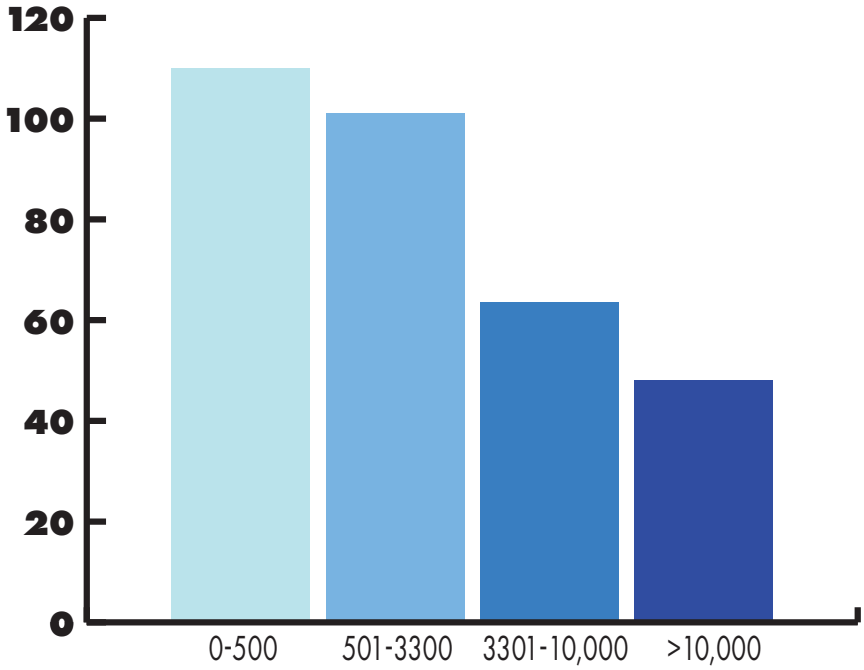
System Size	Max Score	Min Score
0-500	240	5
501-3,300	315	0
3,301-10,000	170	10
>10,000	140	30

System Size	Avg. Infrastructure Need Score
0-500	97.71
501-3,300	115.15
3,301-10,000	73.57
>10,000	75

Figure 4.8 Average infrastructure need scores for small public water systems sorted by system size.

WASTEWATER INFRASTRUCTURE NEED SCORE

Wastewater infrastructure scores ranged from 0-240 with the average value of 93.0 *(Figure 4.10)*. The range of wastewater scores did not show the same variability as the water infrastructure but the mean value was very similar.



System Size	Max Score	Min Score
0-500	210	0
501-3,300	240	0
3,301-10,000	135	30
>10,000	55	40

System Size	Avg. Infrastructure Need Score
0-500	110
501-3,300	101.17
3,301-10,000	63.64
>10,000	48

Figure 4.10 Average infrastructure need scores for small water waste systems sorted by system size.

PUBLIC SEWER SYSTEM, INFRASTRUCTURE NEED COUNTY-WIDE SCORE, CHEROKEE NATION RESERVATION

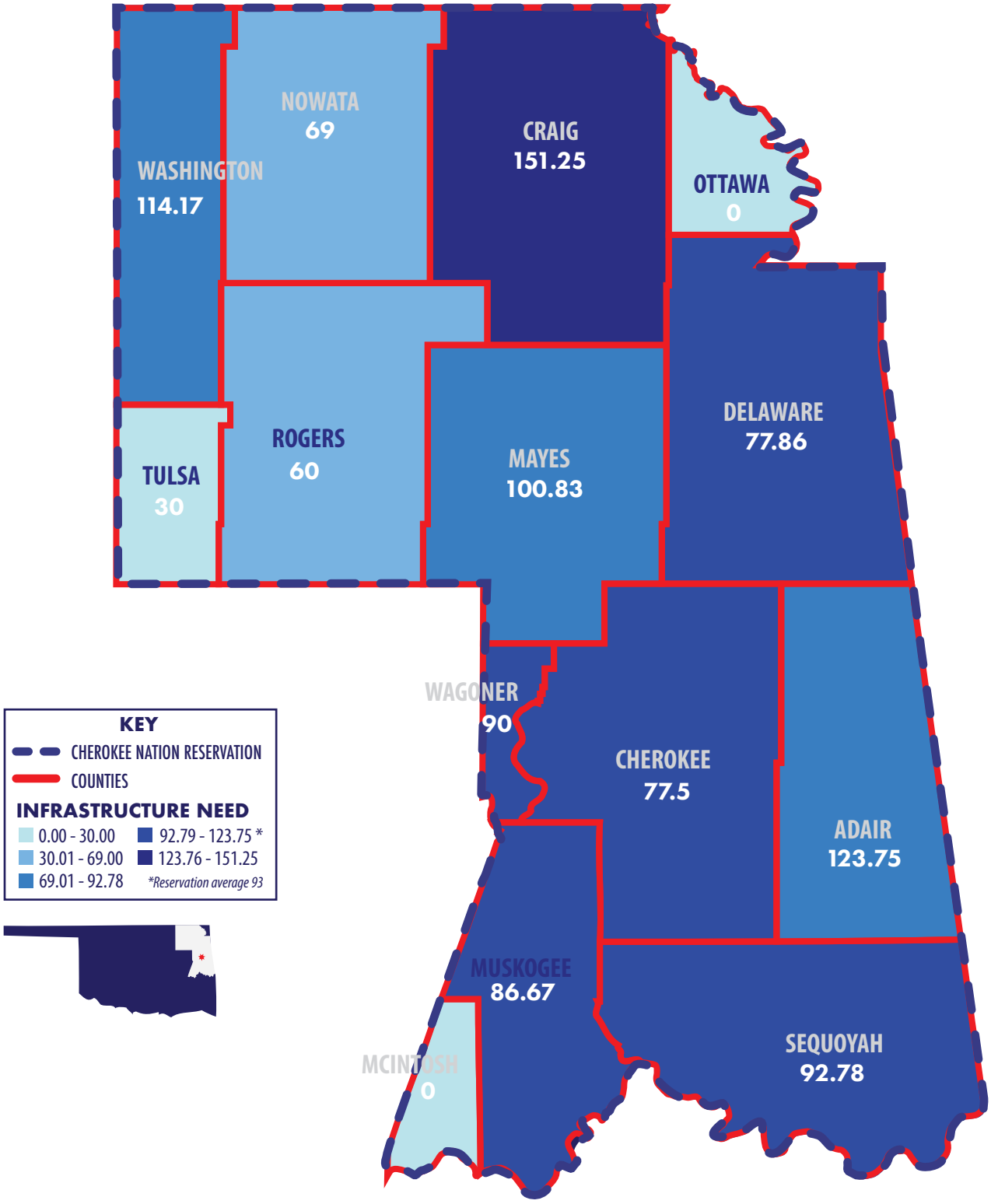


Figure 4.11 Average countywide infrastructure need scores for small public water systems. Higher scores indicate more physical infrastructure needs identified by the systems in the evaluation process.

Contrary to expectations the average water infrastructure scores did not move inversely to system size. Average infrastructure need actually increased as the system size moved from the 0-500 to the 501-3,300 classification. We hypothesize this is due to more of the systems under 500 population being purchased water systems with more of the 501-3,300 population systems having their own water treatment facility and more complex and larger distribution systems. Average infrastructure scores for wastewater systems did move inversely to population size as expected.

Looking at those systems with an infrastructure need score above the mean value, it becomes apparent that those systems also have lower than average TMF capacity, with mean TMF scores dropping to 69.5. This correlation between TMF capacity and infrastructure operation and maintenance cannot be understated. By increasing a water systems capacity to correctly operate and maintain their system the need for significant infrastructure projects will decrease in both number, frequency and scope.

WATER SYSTEMS SELF-IDENTIFIED THEIR MOST PRESSING INFRASTRUCTURE ISSUES WITH THE FOLLOWING OCCURRING MOST FREQUENTLY:

1. Aging Infrastructure (27 systems)
2. Water loss (19 systems)
3. Storage Tanks/Towers (9 systems)
4. Pump Stations (7 systems)
5. Water Treatment Plant (7 systems)

WASTEWATER SYSTEMS SELF-IDENTIFIED THEIR MOST PRESSING INFRASTRUCTURE ISSUES WITH THE FOLLOWING OCCURRING MOST FREQUENTLY:

1. Inflow & Infiltration (15 systems)
2. Aging Infrastructure (13 systems)
3. Lift Station Rehab & Improvement (9 systems)
4. WWTP/Lagoon Rehab (6 systems)

ADDITIONAL DATA NEEDED

Just as with task two, the primary data that is needed to assist in this effort is an accurate, current and complete GIS data set for all water systems across the Cherokee Nation Reservation. As we continue to move forward with the MSWA this data will be critical in assisting water systems in not only evaluating and monitoring the state of their infrastructure but also increasing the TMF capacity to perform such vital tasks as asset management and replacement, inventory monitoring, leak detection and water loss prevention, emergency response, and continuity of operations.

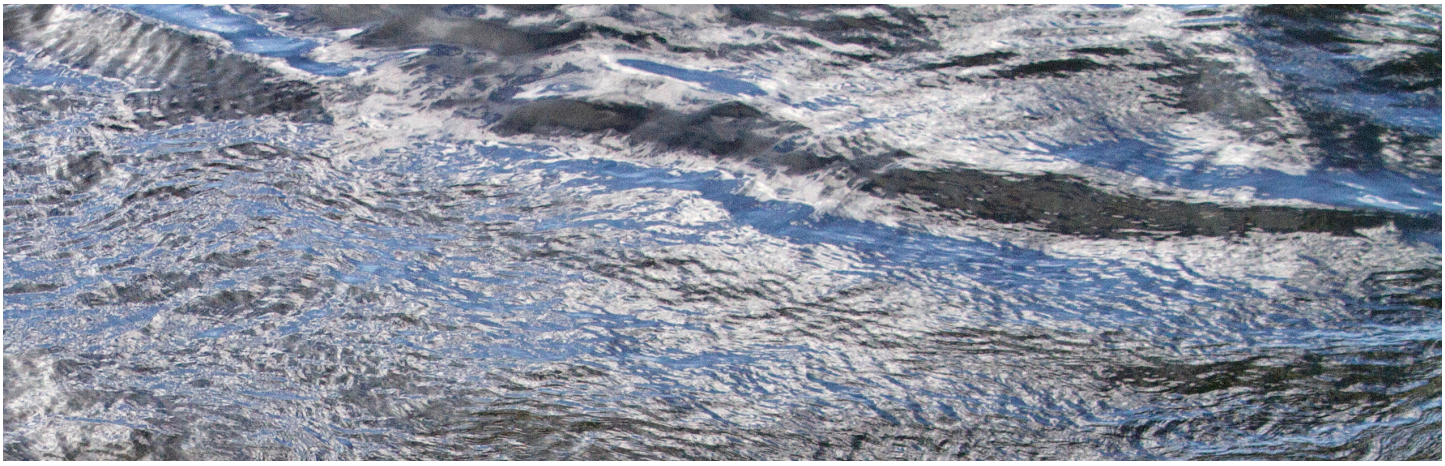
FUTURE PLANS

As we move forward with this task, we will focus our efforts in two primary areas. First, we will focus on the systems with the lowest TMF scores and provide intensive technical assistance and training in partnership with Oklahoma Rural Water Association, Communities Unlimited and other technical assistance providers. Our primary long term goal is to raise all TMF scores above 70 with an average score of 80 or higher. Second, we are developing a comprehensive water GIS dashboard to accurately track water infrastructure and capacity development needs, and be able to quantify and monetize those needs and accurately report on past, present and future projects in real time. As we close the 2022-2024 MSWA reporting period, we will reevaluate these systems to track the TMF improvements and increased sustainability.

SUMMARY

Metric	2022	2024
Number of responses to MSWA Census	4246	1947
Number of responses indicating insufficient water/sewer services in their home.	205	207
Number of homes without access to public water systems [1]	7718	8054
PUBLIC WATER SYSTEMS		
Number of public water systems evaluated n-121	20	121
Highest capacity development score [2]	83.5	96
Lowest capacity development score	39.4	33
Average capacity development score	68.8	73.34
Number of public water systems with capacity development score less than 70%	9	46
Highest water Infrastructure need score [3]	315	315
Lowest water Infrastructure need score	75	0
Average water Infrastructure need score	179.5	101.27
PUBLIC SEWER SYSTEMS		
Number of public sewer systems evaluated n-121	4	53
Highest capacity development score [2]	78.9	96.3
Lowest capacity development score	39.4	33
Average capacity development score	67.52	72.4
Number of public sewer systems with capacity development score less than 70%	2	20
Highest sewer Infrastructure need score [3]	220	240
Lowest sewer Infrastructure need score	95	0
Average sewer Infrastructure need score	181	93

Notes:
1. Analysis based off of Oklahoma Water Resources Board public water system GIS spatial data and homes data from IHS wSTARS data system.
2. Capacity development scores measure the technical, managerial and financial capacity of a water and sewer system to be sustainable. Lower scores indicate more need for technical assistance for the system to be sustainable.
3. Infrastructure need score based on the Indian Health Service listing of standard deficiencies by infrastructure type. Higher scores indicate more infrastructure need and less long term sustainablility. Maximum water infrastructuren eed score = 375, sewer = 260.



ACCOMPLISHMENTS

For the 2022-2024 reporting period the Department of Transportation and Infrastructure have accomplished the following:

1. Completed the evaluation process for both the technical, managerial and financial (TMF) capacity and infrastructure needs for 121 small public water systems and 53 small public sewer systems.
2. Utilized MSWA funding for a lead service line inventory pilot project for 25 small public water systems across the Cherokee Nation Reservation. This pilot project led to an $811,000 grant from the US EPA to complete lead service line inventories for the remaining small public water systems. The lead service line inventory project then resulted in a $5.2 million grant from US EPA to begin lead service line verification projects. These verification projects will occur in 10 of the initial 25 systems in the pilot project. Preliminarly identified are: Adair RWD # 4, Cherokee RWD # 1, Cherokee RWD # 3, Cherokee RWD # 7, Cherokee RWD # 12, Cherokee RWD # 16, Gore, Kenwood, Locust Grove and Welch
3. Moved into new office space at the Male Seminary Recreation Center campus which will allow us to expand our staff to take over some of the MSWA work currently being handled by external consultants.
4. Managed over $61 million in ARPA funded water and wastewater infrastructure projects in addition to the normal IHS project workload.
5. Provided intensive technical, operational and management assistance to Adair Co RWD # 5, Cherry Tree RWD, Locust Grove PWA and Copan PWA.
6. Provided GIS mapping services for eleven public water and sewer systems.
7. Developing the biennial report for submittal to council and administration.

ADDITIONAL RESOURCES NEEDED

To fully execute the goals and purposes of the Mankiller/Soap Water Act it will be necessary to expand our internal capacity to handle some of the workload. Our long term goal is to add additional staff members who will be primarily responsible for the data collection, reporting, and drafting recommendations required by the act. Initially the Department of Transportation and Infrastructure recommends utilizing an engineer along with two engineering technicians, or other similar positions with infrastructure expertise. These positions would be paid primarily out of the Mankiller/Soap Water Act budget. Since the inception of the MSWA, the Department of Transportation and Infrastructure has leveraged MSWA funds to obtain $6.6M in federal grant funds from the US EPA and US Bureau of Reclamation to further the goals of the act.

STRATEGIC VISION

In order to provide the "substantive long-term progress" called for in the Mankiller/Soap Water Act it is necessary to think strategically on how to proceed. In order to meet these long-term goals and objectives, the tasks can be thought of in three overarching terms; Sustainability, Reliability and Affordability.

SUSTAINABILITY

Sustainability can be thought of as a public water systems capacity to deliver high quality water to all of their customers over an extended time horizon. This capacity is integrated not just in the physical infrastructure, but in every facet of the process from source water protection and availability, through the treatment, distribution and consumptive processes, all the way to the final end point of water, in a living organism, a finished product or returned to the atmosphere, aquifer or stream.

Research by the National Resources Defense Council *(Figure 6.1)* indicates that by 2050, eleven of the fourteen counties in the Cherokee Nation Reservation (Cherokee, Delaware, Mayes, McIntosh, Muskogee, Ottawa, Rogers, Sequoyah, Tulsa, Wagoner & Washington) may have water supply sustainability issues.

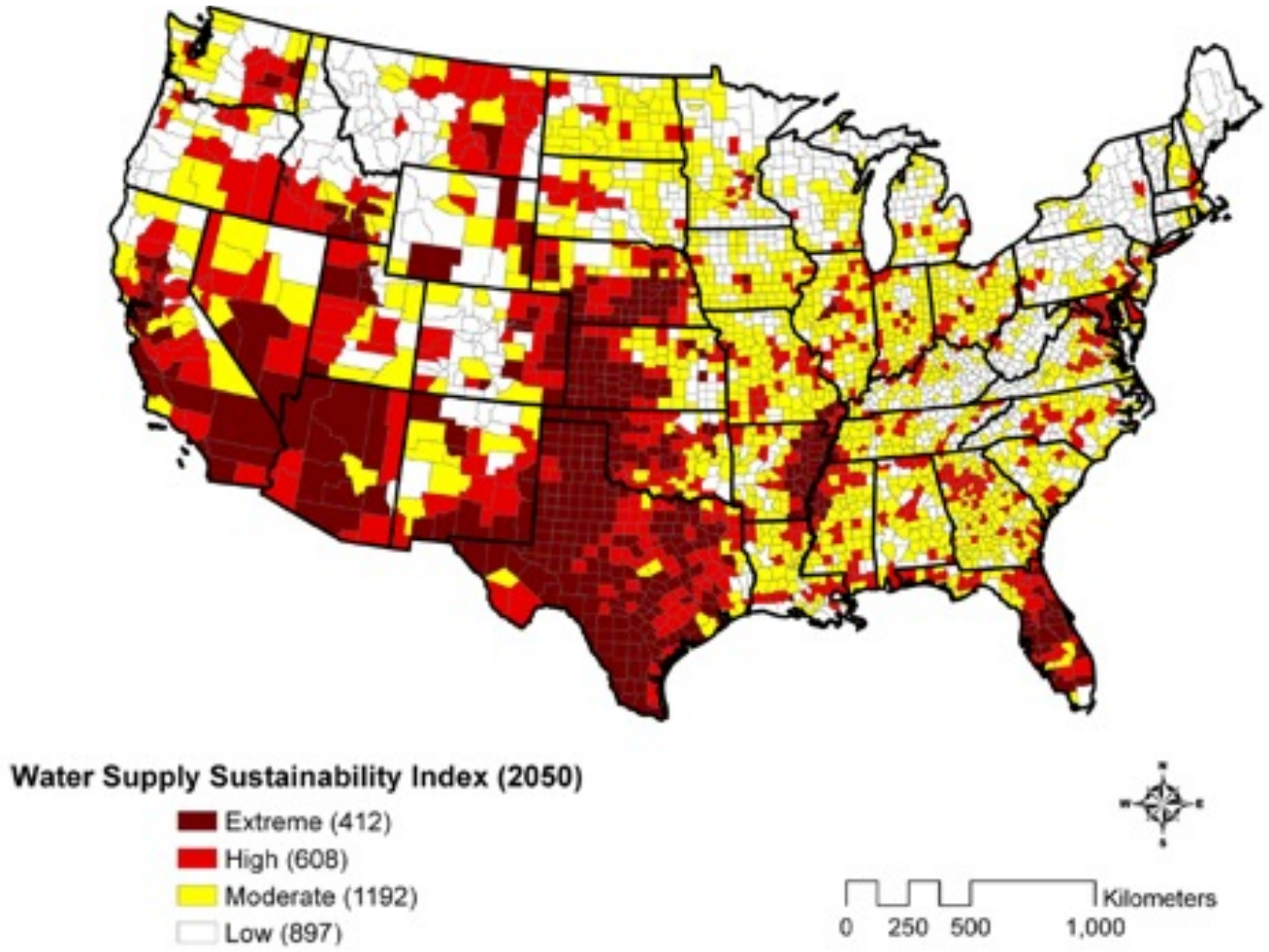


Figure 6.1 Water Supply Sustainability Index in 2050, with available precipitation computed using projected climate change. Source Natural Resources Defense Council 2010

As mentioned earlier in the report, a public water systems technical, managerial and financial (TMF) capacity is critical to achieving sustainability. Smaller water systems, especially those in communities of color and with low socioeconomic metrics tend to have lower TMF capacities *(Shanaghan et al. 2003) a*nd higher incidents of Maximum Contaminant Level (MCL) violations *(Balazs et al. 2012)* than their higher income counterparts. This disparity in TMF capacity leads to inequities in infrastructure investment and funding *(Committee on Small Water Systems 1997)* and affects the water systems ability to leverage internal resources through sustainable rate structures.

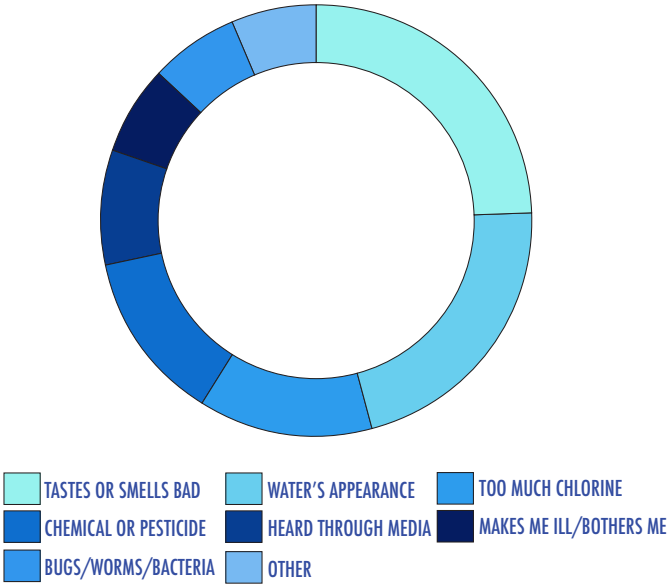
The Mankiller/Soap Water Act gives us the funding to effect a positive change in this area by providing resources to assist water systems to increase their TMF capacity.

THIS COULD BE ACCOMPLISHED BY:

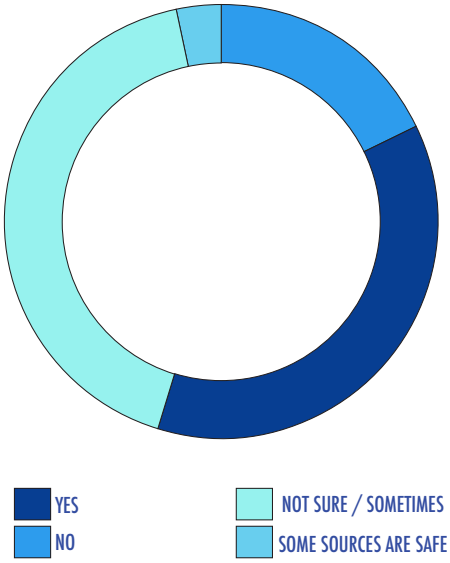
1. Providing training and a recommendation to adopt best management practices
2. Facilitating and encouraging regionalization to bring economies of scale to smaller systems
3. Providing contracted consulting firms to help manage and operate water systems while educating the system staff on the processes and procedures necessary to be sustainable.

Since the Mankiller/Soap Water Act is a continual effort it will be possible to track TMF capacity at the system level and in the aggregate over time to measure the level of improvement and return on investment.

Which of these concerns do you have about your water?



Do you think the water in your home is safe to drink?



Several questions in the 2024 Mankiller/Soap Water Survey asked about the respondents impression of the water quality in their home. When asked if they think the water in their home is safe to drink, 355 (18%) respondents answered "No", 727 (37%) responded "Not Sure" and 62 (3%) responded "Some sources are safe but not all".

Additionally, citizens were given the opportunity to indicate concerns about their water safety. More than one response could be selected if the respondent had multiple concerns.

Survey participants could also manually enter responses for other concerns that they may have. These responses were evaluated and common concerns were used to generate a word cloud to visualize the frequency of common occurrences.

Many of the concerns focused on the water quality tests results that are required by the Safe Drinking Water Act to be communicated to the water customers by the utility. These consumer confidence reports (CCR) are written in a very technical manner and can be difficult to read or interpret for an average consumer. These CCR's may be responsible for the high number of citizens who think that the water in their home is unsafe to drink. There may be an opportunity to help water systems improve their communication methods and language to help alleviate some of these concerns.

RELIABILITY

A water system's ability to provide water at sufficient pressure and volume for all their customers, while complying with all aspects of the Safe Drinking Water and Clean Water Acts can be thought of as reliability.

In spite of the recent Infrastructure Investments & Jobs Act (IIJA), American Rescue Plan Act (ARPA) and Inflation Reduction Act (IRA) federal investment in water infrastructure has been on a downward trajectory for the past 40+ years *(Figure 6.2)*. Examining the federal investment both as a percentage of total infrastructure investment and comparing to other infrastructure categories it is easy to see the disparity *(Figure 6.3)*. The US Water Alliance and the American Society of Civil Engineers estimate that an additional $82 Billion per year is needed to make up this funding shortfall *(US Water Alliance)*. For reference the IIJA appropriated $55 billion for water infrastructure, a huge increase from the baseline funding but was only 10% of the total infrastructure appropriation behind broadband, passenger and freight rail, power and grid, and roads & bridges.

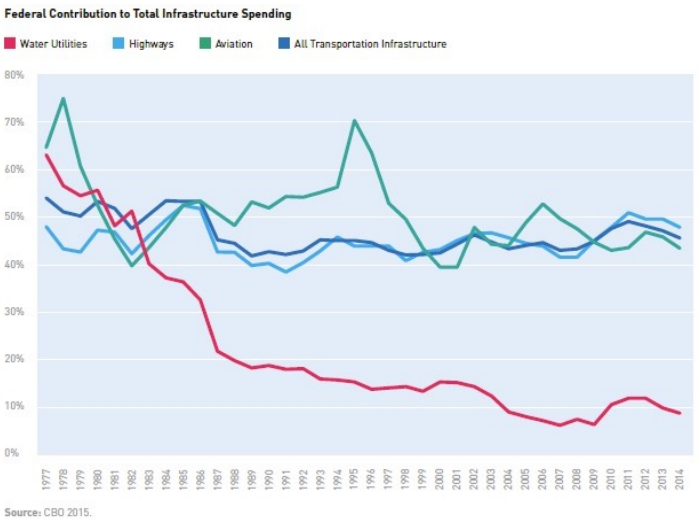


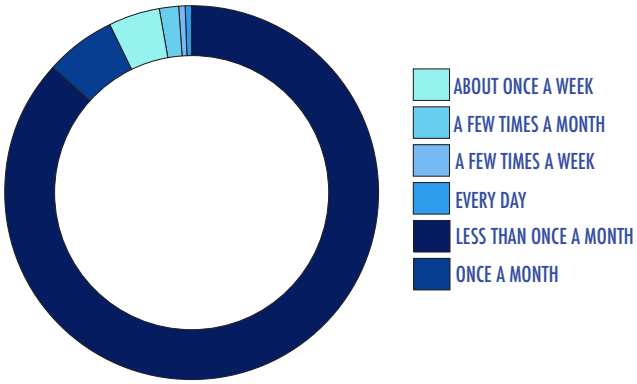
Figure 6.2 Federal Contributions to Total Infrastructure Spending (1977-2015)
Source: Congressional Budget Office 2015

Figure 6.3 Annual Federal Investment Per Capita for various types of infrastructure spending. Source CBO 2013, 2015 & Governmental Accounting Office 2016.

The lack of federal investment over the last four decades is now becoming readily apparent. As water systems age, they require more intense and frequent maintenance. Eventually, they reach the end of their useful service life and require replacement. Utilizing funding through the Mankiller/Soap Water Act, it is hoped that substantial positive change can be fostered to increase the reliability of the public water systems across the Cherokee Nation Reservation. Improvements to reliability will also increase the sustainability of each system by reducing water loss, providing adequate pressure and volume, and assisting with long term capital improvement plans.

In the 2024 Mankiller/Soap water survey, respondents were asked about the reliability for the water systems that serve them based on the frequency of water outages experienced. Out of the 1,947 responses, 33 indicated they experienced water outages daily, 24 experienced water outages a few times a week, 121 experienced water outages a few times per month, 26 experienced water outages about once a week, 78 experienced water outages about once a month and 1,665 experienced water outages less than one time per month.

How often have you experienced a water outage?



This level of unreliability is not acceptable, and we will need to find ways to help public water systems bolster their infrastructure and improve reliability to their customers.

AFFORDABILITY

The third element of the strategy is affordability. EPA recommends an affordability measure of no more than 2.5 % of median household income be expended toward monthly water costs. *(US EPA 2003)* In water systems with low household incomes this represents an amount that might make the system unsustainable. If rates are raised to make the system sustainable then the customer base is faced with unaffordable water rates. Using the Mankiller/Soap Act, affordability metrics can be measured against median household incomes and relative water affordability can be compared. By assisting public water systems in reducing debt ratios, maximizing water revenues by reducing actual and apparent water loss, encouraging and facilitating conservation, promoting regionalization and improving TMF capacity, it is hoped that water systems can maintain affordable rates while also providing sufficient revenue to make the system sustainable.

For the 2024-2026 MSWA reporting period, the Department of Transportation and Infrastructure plan to begin work on a comprehensive water rates study for all small public water systems across the Cherokee Nation Reservation. This study will examine the current water rate structures, compare to census income data and assess the affordability of water for customers of each water system based on the EPA's recommended 2.5% metric. The rates will also be examined against other emerging metrics of affordability *(Skerker et al. 2024)* in order to assess the impact of water rates on system sustainability.

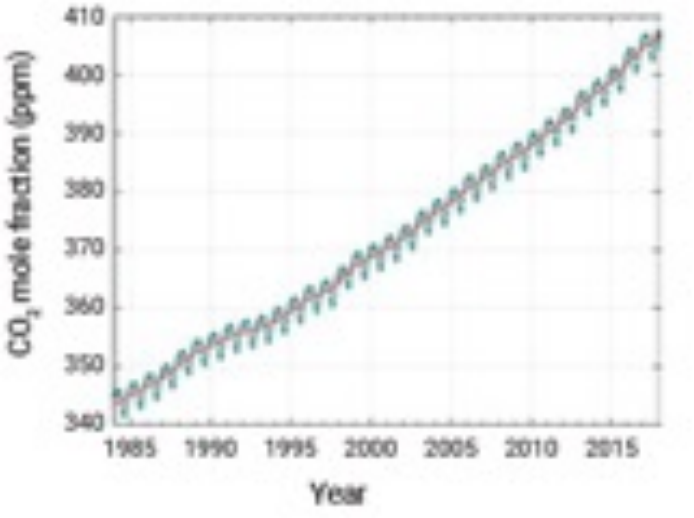


Figure 6.4 Increasing levels of CO2 in the atmosphere. Source: WMO 2019

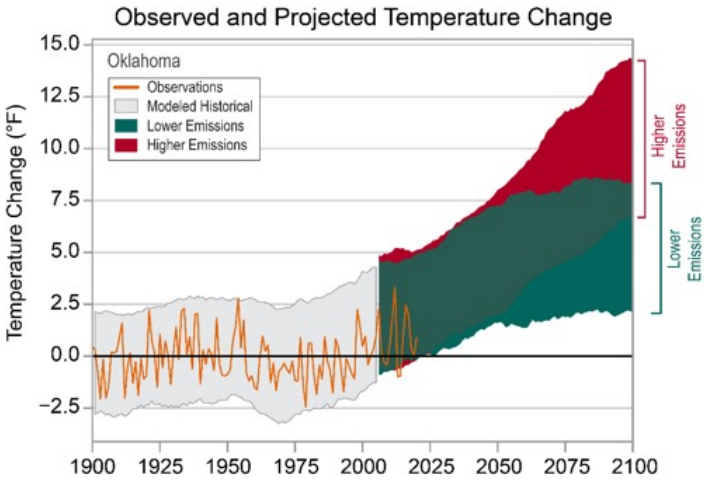


Figure 6.5 Observed and Projected Temperature Change (Oklahoma). Source NOAA National Centers for Environmental Information 2022

CLIMATE CHANGE AND RESILIENCY

The current, ever-changing climate and its potential to impact water demand, availability, and infrastructure warrant inclusion in this report and consideration for future planning efforts. The geological record is filled with evidence of a changing climate so why is the current situation of critical importance? The fact is that the emission of greenhouse gases over the past 100 years has led to atmospheric concentrations of carbon dioxide well above the average amounts found in ice cores dating back over 800,000 years. During the last 10,000 years global CO2 amounts in our atmosphere have ranged from 260 – 280 parts per million (ppm) until about the end of the 19th century when the concentration began to increase significantly. Current CO2 concentrations are above 330 ppm and show no signs of slowing *(Figure 6.4)*. The addition of CO2 traps solar radiation near the surface results in atmospheric warming *(Figure 6.5)*. Since the beginning of the 20th century, temperatures in the contiguous United States have risen by approximately 1.8° F. Additionally, recently atmospheric modeling predicts that a significant reduction in summer precipitation is likely for much of the Cherokee Nation Reservation during the middle of the 21st century *(Figure 6.6)*.

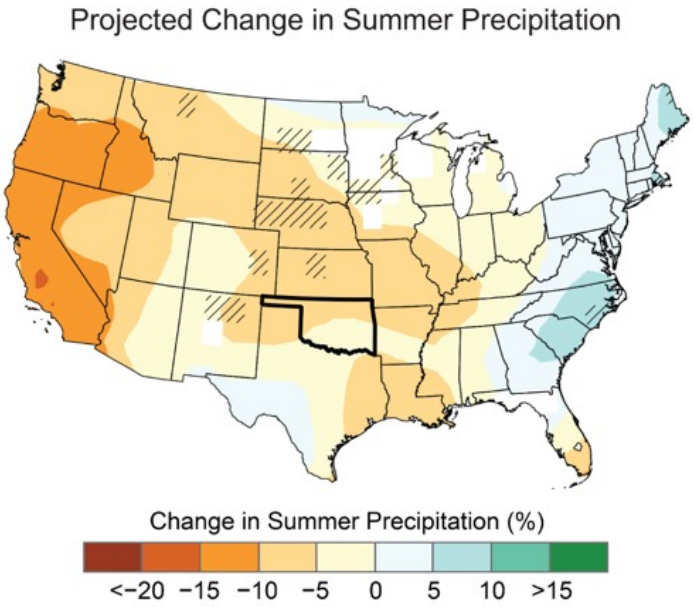


Figure 6.6 Projected changes in total summer (June–August) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. Whited-out areas indicate that the climate models are uncertain about the direction of change. Hatching represents areas where the majority of climate models indicate a statistically significant change. Precipitation in the summer is projected to decrease slightly in Oklahoma, but the changes are smaller than natural variations. Sources: CISESS and NEMAC. Data: CMIP5. (Frankson, et al. 2022)

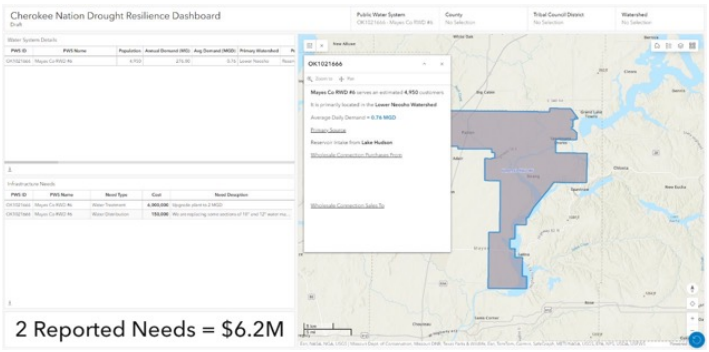


Figure 6.5 Screenshot from the Cherokee Nation Drought Resilience Dashboard, currently under development.

A RECENT REPORT FROM THE UNIVERSITY OF OKLAHOMA CONCLUDED THAT:

1. Native Americans are the most vulnerable communities in Oklahoma among five major communities (vulnerability in a decreasing order: Native American. Hispanic. African. Asian. White).
2. Heavy rainfall and 2-yr flood risks are projected to be much greater in the future (increase by 501.1% and 632.6%) for Native Americans, driven by climate and demographic changes. Flash-flood risk has a moderate increase (296.4%).
3. Native Americans bear 68.0%, 64.3%, and 64.0% higher risks in heavy rainfall, 2-yr flooding, and flash flooding than general population in Oklahoma.
   (Li et al. 2024)

Utilizing resources from the Mankiller/Soap Water Act, the Department of Transportation and Infrastructure was selected to receive a $400,000 grant from the US Bureau of Reclamation (USBR) to incorporate drought planning and risk assessment into the evaluation process. The initial drought study focused on the five watersheds in the Cherokee Nation Reservation most susceptible to the effects of drought. These watersheds occur in the northern and western portions of the reservation and specifically are: Bird and Caney, Middle and Upper Verdigris, and the Lower Neosho. This project will create a Cherokee Nation Drought Resilience Dashboard *(Figure 6.5)* that will be the starting point for a comprehensive Water GIS dashboard for the Cherokee Nation. This initial dashboard will allow findings of the drought resiliency study (Appendix C) to be summarized by public water system, county, Cherokee Nation council district, the entire Cherokee Nation Reservation or by watershed. It will include public water system information, population and water demand projections, infrastructure needs and potential drought management strategies and costs. It is hoped that this will lead to an additional grant funding from the USBR to complete the dashboard for the remaining five watersheds and eventually lead to grant funding to implement some of the drought management strategies and infrastructure improvements identified in the report.

While drought planning is a major concern, it is also necessary to consider the effects of pluvial periods on water systems. These prolonged and often severe events can affect the operation of water and wastewater systems by changing the quality of source water supplies, inundating critical infrastructure, washing out water distribution pipelines and disrupting power supplies. In the past few years, the Department of Transportation and Infrastructure has assisted with emergency repairs due to flooding for Cherry Tree RWD, Adair RWD # 2, Adair RWD # 4, Cherokee Co RWD # 1, Cherokee Co RWD # 7, Cherokee Co RWD # 13, Rogers Co RWD # 3 and the East Central OK Water Association. Mankiller/Soap Water Act evaluations, along with accurate GIS data, can assist us with developing a comprehensive, risk based inventory of critical infrastructure that may be affected by these peak flow events and allow us to develop a proactive plan to address these issues before they occur rather than waiting until disaster strikes.

Washed out waterline – Oak Ridge, Adair Co, OK. Photo by Cherry Tree Rural Water District 10/24/19

Additionally, evidence for the impact of climate change can be found in the frequency and magnitude of flooding events along the Illinois River near Tahlequah, OK, where four of the six largest recorded flooding events have occurred since 2011, including the flood of record which occurred in 2015. *(National Weather Service 2022)* The increased frequency and magnitude of these events underscores the need to include climate change resiliency in the Mankiller/Soap priorities and evaluation process.

PFAS

Per and Polyfluoroalkyl Substances, commonly referred to as PFAS, are a family of chemicals used in many industrial applications including firefighting foam, chrome plating, electronics manufacturing, and textiles. These substances do not break down in the environment, tend to be very water soluble and have been shown to have adverse health effects including:

- Reproductive effects such as decreased fertility or increased high blood pressure in pregnant women.
- Developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes.
- Increased risk of some cancers, including prostate, kidney, and testicular cancers.
- Reduced ability of the body's immune system to fight infections, including reduced vaccine response.
- Interference with the body's natural hormones.
- Increased cholesterol levels and/or risk of obesity.

Source US EPA 2022

On April 10, 2024, the US EPA announced the final National Primary Drinking Water Regulation for six PFAS. The final rule requires that public water systems must monitor for these PFAS and have until 2027 to complete that initial monitoring, followed by ongoing compliance monitoring. Beginning in 2027 public water systems must also notify their customers about the levels of PFAS in their water. Public water systems have until 2029 to implement solutions to reduce the levels of PFAS if found in levels above the maximum contaminant limit (MCL). Beyond 2029 if PFAS is found in levels above the MCL the public water system must take actions to reduce the level and notify their customers of the violation.

Compound	Final MCL Goal	Final MCL (enforceable levels)
PFNA	10 ppt	10 ppt
HFPO-DA (commonly known as GenX Chemicals)	10 ppt	10 ppt
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard index	1 (unitless) Hazard index

Compound	Final MCL Goal	Final MCL (enforceable levels)
PFOA	Zero	4.0 parts per trillion (ppt) (also expressed as ng/L)
PFOS	Zero	4.0 ppt
PFHxS	10 ppt	10 ppt

Source US EPA 2024

For the 2024-2026 reporting period the Department of Transportation and Infrastructure will begin assisting public water systems with their initial PFAS monitoring and, when necessary, assist in identifying, funding and implementing solutions to PFAS contamination.

We are aware that through the EPA's Unregulated Contaminant Monitoring Rule (UCMR5) testing there are several public water systems across the Cherokee Nation Reservation that had PFAS levels above the new MCL. The UCMR5 only tested a small number of the 121 small public water systems so we anticipate that there will be additional public water systems that will need to be tested and evaluated to determine if a PFAS issue exists and how best to mitigate the issue.

The cost to treat for PFAS may be a major issue with the existing technologies that have been shown to effective having very high initial costs as well as high on going operation and maintenance costs. These types of treatment systems may be too expensive or complex for some small public water systems and facilitate the need for additional regionalization or consolidation solutions.

LEAD AND COPPER RULE REVISIONS

The 2021 Lead and Copper Rule Revisions required all public water systems to complete an inventory of all water service lines in order to identify known lead service lines as well as all water service lines of unknown materials. The Department of Transportation and Infrastructure began a pilot project in 2022 funded by the MSWA to assist ten small public water systems with preparation of these inventories. This initial pilot project was very well received and expanded to an additional fifteen small public water systems. This project led to a $811,000 lead service line inventory grant from the US EPA to inventory the remaining small public water systems across the reservation. As a result of this effort all of the small public water systems were able to submit their completed inventories prior to the regulatory deadline of October 16, 2024.

The next step of this process will be to assist water systems in the effort to verify the composition of unknown water service lines and update their inventories accordingly. The proactive approach taken by the Department of Transportation and Infrastructure led to a $5.2 million grant from the US EPA to assist the initial 10 systems in the Lead Service Line Inventory pilot project with a communications and verification project to eliminate the unknown water service lines in their inventories.

The Department of Transportation and Infrastructure will continue to work proactively for all small public water systems across the reservation and advocate for the resources they need to comply with the EPA lead service line regulations.

RECOMMENDATIONS FOR FUTURE WORK

In conclusion the Department of Transportation and Infrastructure would like to offer these recommendations for the Mankiller/Soap Water Act in order to improve public knowledge and perception of the act, improve our capacity to make scientifically sound and data driven decisions, improve long range planning, and assist our local community run water and wastewater utilities in being more sustainable:

- Improve outreach to Cherokee citizens to expand data gathered through Gadugi Portal survey.
- Work with Cherokee Nation Communications to develop other outreach and data gathering methods.
- Continue to develop external and internal partnerships necessary to gather the required data to make accurate and timely conclusions and recommendations.
- Prioritize activities to build water system TMF capacity, provide sustainability, reliability, and affordability based on completed evaluations.
- Develop data to complete GIS data set for all water systems within the Cherokee Nation Reservation and integrate all MSWA work into a comprehensive GIS dashboard for project planning, tracking and reporting purposes.
- Assist small public water systems with the new PFAS regulations.
- Continue working with Lead Service Line verification and replacement projects.
- Consider reactivation of the Cherokee Nation water planning workgroup that was begun in 2014 under the Secretary of Natural Resources.

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APPENDICES

Appendix A

Project	Project Name	Priority	DL	Total Score	Eligible Homes	Eligible Project Cost	Cumulative Elig. Project Cost	Ineligible Project Cost	Total Project Cost
OK21999-0F01	CHEROKEE / Adair RWD #5 - Water Source_System Improvements	1	3	74	$3,057,242.00	$3,057,242.00	$3,057,242.00	$3,057,242.00	$8,913,242.00
OK11999-0010	CHEROKEE / Multi-County-Individual Water & Sewer DL3/4/5	2	3	73	$0.00	$0.00	$0.00	$0.00	$997,000.00
OK01109-0U01	CHEROKEE / Cherry Tree - Sewer System Rehabilitation	7	3	66	$37,613.00	$37,613.00	$37,613.00	$37,613.00	$783,613.00
OK51684-0T01	CHEROKEE / Warner UA - Wastewater Treatment Plant Improvements	22	3	59	$2,074,707.00	$2,074,707.00	$2,074,707.00	$2,074,707.00	$2,481,707.00
OK74961-0T01	CHEROKEE / Ochelata - Sewer System Rehab	28	3	57	$571,848.00	$571,848.00	$571,848.00	$571,848.00	$684,848.00
OK66881-0S01	CHEROKEE / Oologah PWA - WWTP Improvements	32	3	56	$1,794,889.00	$1,794,889.00	$1,794,889.00	$1,794,889.00	$2,188,889.00
OK53999-0A01	CHEROKEE / Nowata #5 - Water System Improvements	46	3	50	$295,000.00	$295,000.00	$295,000.00	$295,000.00	$590,000.00
OK49651-0A01	CHEROKEE / Chouteau PWA - Water System Improvements	51	3	49	$7,497,861.00	$7,497,861.00	$7,497,861.00	$7,497,861.00	$8,141,000.00
OK01055-0A01	CHEROKEE / Westville UA - Water Storage Expansion	52	3	49	$1,939,614.00	$1,939,614.00	$1,939,614.00	$1,939,614.00	$2,903,614.00
OK11191-0A01	CHEROKEE / Cherokee 13 - 559 Rd Water Line	74	3	40	$0.00	$0.00	$0.00	$0.00	$233,000.00
OK73999-0D01	CHEROKEE / Wagoner RWD #2 - WTP Improvements	76	2	39	$6,979,742.00	$6,979,742.00	$6,979,742.00	$6,979,742.00	$7,967,742.00
OK53702-0A01	CHEROKEE / Nowata RW&SD #1 - Petty WL Extension	81	3	37	$0.00	$0.00	$0.00	$0.00	$621,000.00
OK11999-4A01	CHEROKEE / Wagoner RWD #9 - Water Treatment Plant Rehab	86	2	35	$3,410,267.00	$3,410,267.00	$3,410,267.00	$3,410,267.00	$5,693,267.00
OK21305-0B01	CHEROKEE / Kansas PWA - Water Distro System Rehab	92	2	34	$1,683,064.00	$1,683,064.00	$1,683,064.00	$1,683,064.00	$2,083,000.00
OK21999-0T01	CHEROKEE / Colcord PWA - Sewer System Improvements	98	2	32	$1,211,714.00	$1,211,714.00	$1,211,714.00	$1,211,714.00	$2,111,000.00
OK51684-0B0	CHEROKEE / Warner UA - Water Treatment Plant Expansion	113	2	26	$11,292,627.0	$11,292,627.0	$11,292,627.0	$11,292,627.0	$13,459,627.00

System Name	Infrastructure Need Score	CapDev Score
Adair Co RWD 2	170	62.4
Adair Co RWD 3	115	69.7
Adair Co RWD 4	230	56
Adair Co RWD 5	120	76.1
Afton PWA	30	82.6
BarDew Water	100	68.8
Bernice	225	53.2
Big Cabin	175	74.3
Braggs PWA	145	62.4
Burnt Cabin	240	58.7
Catoosa PWA	30	88.1
Chelsea UA	15	69.7
Cherokee Co RWD 1	250	73.4
Cherokee Co RWD 11	90	81.7
Cherokee Co RWD 12	90	82.6
Cherokee Co RWD 13	170	66.1
Cherokee Co RWD 16	315	73.4
Cherokee Co RWD 2	245	59.6
Cherokee Co RWD 3	120	83.5
Cherokee Co RWD 7	70	80.7
Cherokee Co RWD 8	95	75.2
Cherry Tree RWD	255	33
Chouteau	140	72.5
Claremore PWA	30	92.7

Colcord PWA	40	68.8
Collinsville PWA	65	84.4
Copan PWA	105	53.2
Craig Co RWD 1	5	66.1
Craig Co RWD 2	30	85.3
Craig Co RWD 3	80	88.1
Delaware Co RWD 1	90	68.8
Delaware Co RWD 10	125	79.8
Delaware Co RWD 3	30	81.7
Delaware Co RWD 7	60	56
Delaware PWA	155	47.7
Dewey PWA	55	81.7
East Central Water Authority	120	83.5
Elm Bend RWD	0	89
Fairland	15	76.1
Fort Gibson PWA	45	87.2
Gans PWA	45	57.7
Gore	75	78.9
Grand Lake PWA	30	96.3
Grove	100	93.6
Hulbert PWA	175	66.1
Ironside Water System	70	56.9
Jay UA	60	62.4
Kansas PWA	40	78
Kenwood Water District	120	64.2
Ketchum Delaware	135	95.4

Ketchum PWA	105	95.4
Langley	160	67.9
Leann Water District	165	73.4
Lee Creek RWD	95	87.2
Lenapah PWA	120	83.5
Locust Grove	235	39.4
Mayes Co RWD 2	35	84.4
Mayes Co RWD 3	95	71.6
Mayes Co RWD 4	25	59.6
Mayes Co RWD 5	110	89
Mayes Co RWD 6	85	90.8
Mayes Co RWD 7	155	76.1
Mayes Co RWD 8	40	88.1
Mayes Co RWD 9	195	64.2
McIntosh Co RWD 5	20	89.9
Mcintosh Co RWD 8	150	92.7
Mid America Industrial Park	10	78.9
Muldrow PWA	90	58.7
Muskogee Co RWD 2	60	80.7
Muskogee Co RWD 7	65	71.6
Nowata Co RWD 1	165	89
Nowata Co RWD 2	150	51.4
Nowata Co RWD 3	80	40.4
Nowata Co RWD 5	80	38.5
Nowata Co RWD 6	115	59.6
Nowata Co RWD 7	145	50.5

Nowata Consolidated RWD 1	125	65.1
Nowata PWA	40	71.6
Ochelata PWA	95	56
Okay PWA	75	58.7
Ottawa Co RWD 6	95	76.1
Peggs	90	88.1
Porum	170	86.2
Pryor	70	72.5
Ramona PWA	165	71.6
Rogers Co RWD 2	140	71.6
Rogers Co RWD 3	110	90.8
Rogers Co RWD 4	85	72.5
Rogers Co RWD 5	140	75.2
Rogers Co RWD 6	35	76.1
Rogers Co RWD 7	5	95.5
Rogers Co RWD 8	40	89
Roland PWA	55	78
Salina PWA	30	77.1
Sallisaw PWA	110	74.3
Sequoyah Co RWD 3	75	49.5
Sequoyah Co RWD 4	95	76.1
Sequoyah Co RWD 5	190	62.4
Sequoyah Co RWD 7	45	83.5
South Coffeyville PWA	150	74.3
South Delaware RWA	15	88.1
Spavinaw	10	82.6

Sperry	20	78.9
Stick Ross Mtn	230	67
Stilwell	50	89
Tahlequah PWA	50	79.8
Vera	125	50.5
Vian PWA	30	69.7
Vinita PWA	50	83.5
Wagoner Co RWD 2	130	41.2
Wagoner Co RWD 7	30	76.1
Wagoner Co RWD 9	75	90.8
Warner PWA	115	72.5
Washington Co RWD 1	165	88.1
Washington Co RWD 2	210	89
Washington Co RWD 3	45	69.7
Washington Co RWD 5	140	73.4
Washington Co RWD 7	95	67.9
Watts	105	64.2
Welch PWA	180	77.1
West Siloam Springs PWA	170	58.7
Westville PWA	30	86.2

System Name	Infrastructure Need Score	CapDev Score
Afton PWA	70	82.6
Big Cabin	210	74.3
Braggs PWA	85	62.4
Catoosa PWA	65	88.1
Chelsea UA	75	69.7
Cherry Tree RWD	240	33
Chouteau	105	72.5
Claremore PWA	40	92.7
Colcord PWA	65	68.8
Collinsville	60	84.4
Copan	160	53.2
Delaware PWA	110	47.7
Dewey PWA	60	81.7
East Central OK Water	110	83.5
Fort Gibson PWA	110	87.2
Gans PWA	150	57.7
Gore	95	78.9
Grand Lake PWA	30	96.3
Grove	45	93.6

Hulbert PWA	**100**	**66.1**
Jay UA	**155**	**62.4**
Kansas PWA	**35**	**78**
Kenwood PWA	**145**	**64.2**
Ketchum PWA	**40**	**95.4**
Langley	**195**	**67.9**
Leann Water District	**110**	**73.4**
Lenapah PWA	**115**	**83.5**
Locust Grove	**185**	**39.4**
Marble City PWA	**115**	**45**
Mid America Industrial Park	**30**	**78.9**
Muldrow PWA	**90**	**58.7**
Nowata Co RWD 1	**0**	**89**
Nowata PWA	**35**	**70.6**
Ochelata PWA	**105**	**56**
Okay PWA	**90**	**58.7**
Porum PWA	**65**	**86.2**
Pryor PWA	**70**	**72.5**
Ramona PWA	**125**	**71.6**
Roland PWA	**45**	**78**
Salina PWA	**20**	**77.1**
Sallisaw PWA	**50**	**74.3**

South Coffeyville PWA	**85**	**74.3**
Sperry	**0**	**78.9**
Stilwell ADA	**195**	**89**
Tahlequah PWA	**55**	**79.8**
Vera PWA	**125**	**50.5**
Vian PWA	**100**	**69.7**
Vinita	**135**	**83.5**
Warner PWA	**80**	**72.5**
Watts	**25**	**64.2**
Welch	**220**	**77.1**
West Siloam Springs PWA	**70**	**58.7**
Westville PWA	**35**	**86.2**

1. BACKGROUND

The Cherokee Nation (Nation) received a grant from the US Bureau of Reclamation to perform a Drought Resilience Study for selected communities with populations of 10,000 or less within the Nation. The study includes four main objectives:

1. Identify public waters systems (PWS) within the Nation with populations less than 10,000 to include in the analysis. Examine and rank all HUC 8 watersheds within the Nation (Figure 1) to determine the top 5 most drought prone watersheds to focus on for the Drought Resilience Study.
2. Assess the current status and infrastructure needs of water systems within the Nation's boundaries with emphasis on systems within the identified focus watersheds.
3. Evaluate the drought resiliency of existing water supplies given current climate variability. This will include both surface and groundwater supplies. Projected future water demands will be developed on a utility-by-utility basis.
4. Identify drought planning options such as demand management, increasing supply resilience, and evaluation of drought resilient supplies. Develop cost estimates for each utility to mitigate impacts.

FNI partnered with Oklahoma Alliance Consultants (OKAC) to reach an agreement with the Nation to complete Phase 1 of the Drought Resilience Study which includes the first three objectives. The approach used to complete Objective 1, the PWS inventory and watershed selection process, is described in Section 2 and Section 3, respectively.

The remainder of this memo focuses on Objectives 2 and 3 of the study, which includes the development of population and water demand projections, and assessment of current water supply and infrastructure needs for rural water systems within the five focus watersheds.

2. PUBLIC WATER SYSTEM INVENTORY

Prior to the watershed scoring analysis, an inventory of PWS with populations of 10,000 or less within the Nation was developed. This inventory includes PWS whose service areas reside within or overlap the Nation boundary. The Nation provided an initial list of 132 systems which was used as a starting point along with the Oklahoma Water Resources Board (OWRB) GIS database of PWS service areas. The PWS list from the Nation was matched to the service area layer from OWRB to confirm if the systems were located fully or partially within the Nation boundary. Some systems from the Nation list were not included in the OWRB service area layer, but these were confirmed to be located within the Nation by their physical address location. Additional systems from the OWRB layer were added to the system inventory if a significant portion of the service area was located within the Nation boundary and the estimated system population was less than 10,000. Some systems with populations greater than 10,000 were included in the inventory if they provided wholesale water supplies to other systems with populations less than 10,000 within the Nation.

Two sources were used for water system population. The first was from community water system evaluations conducted as part of the Wilma Mankiller and Charlie Soap Water Act (MSWA). These evaluations were conducted for most of the systems included in the initial PWS list from the Nation, and many of them reported a population served, or number of connections. Populations were estimated for systems that reported connections instead of population by assuming a total of 2.5 persons per connection, which is a standard assumption for rural water systems in Oklahoma. Overall, 105 had estimated populations from the MSWA evaluations. PWS populations were also estimated using GIS analysis and 2020 Census block data. The population of census blocks that fell fully or partially within a systems service area were summed to estimate the systems total population. For blocks that were located partially within the PWS service area, the population was adjusted by the portion of the block's area within the PWS service area. For example, if 50 percent of the block was located within the service area, then 50 percent of the block's population was assumed to be within the system service area. This method assumes that the population of the block is evenly distributed spatially, which is typically not the case. However, this was the most feasible method to estimate population for systems without available population data.

After adding several additional systems that were not included in the initial list from the Nation, a total of 137 systems within the Nation were identified either with population of 10,000 or less, or with over 10,000 if they provide wholesale water supplies to any of the systems under 10,000. Each of these systems was assigned to one of the ten HUC 8 watersheds shown in Figure 1 as their primary watershed based on which watershed the majority of the system service area was located. For the systems with unknown service area boundaries, the primary watershed was assigned based on the physical address for the system. Information on the water sources for each PWS was gathered from the Oklahoma Drinking Water Watch (DWW) database. The name of the reservoir(s), river(s), spring(s) or number of wells were listed for systems that divert water directly from the source. For systems that purchase water from another system, the name of the system they purchase from was listed along with the water source it originates from. This is referred to as the indirect source. For example, Adair gets water directly from Adair City Lake, but also purchases water from Mayes Co RWD #6 whose direct water source is Lake Hudson. Thus, Adair has a direct water source from Adair City Lake and an indirect water source from Lake Hudson via Mayes Co RWD #6. Water source information is an important factor in the evaluation of a system's drought resilience.