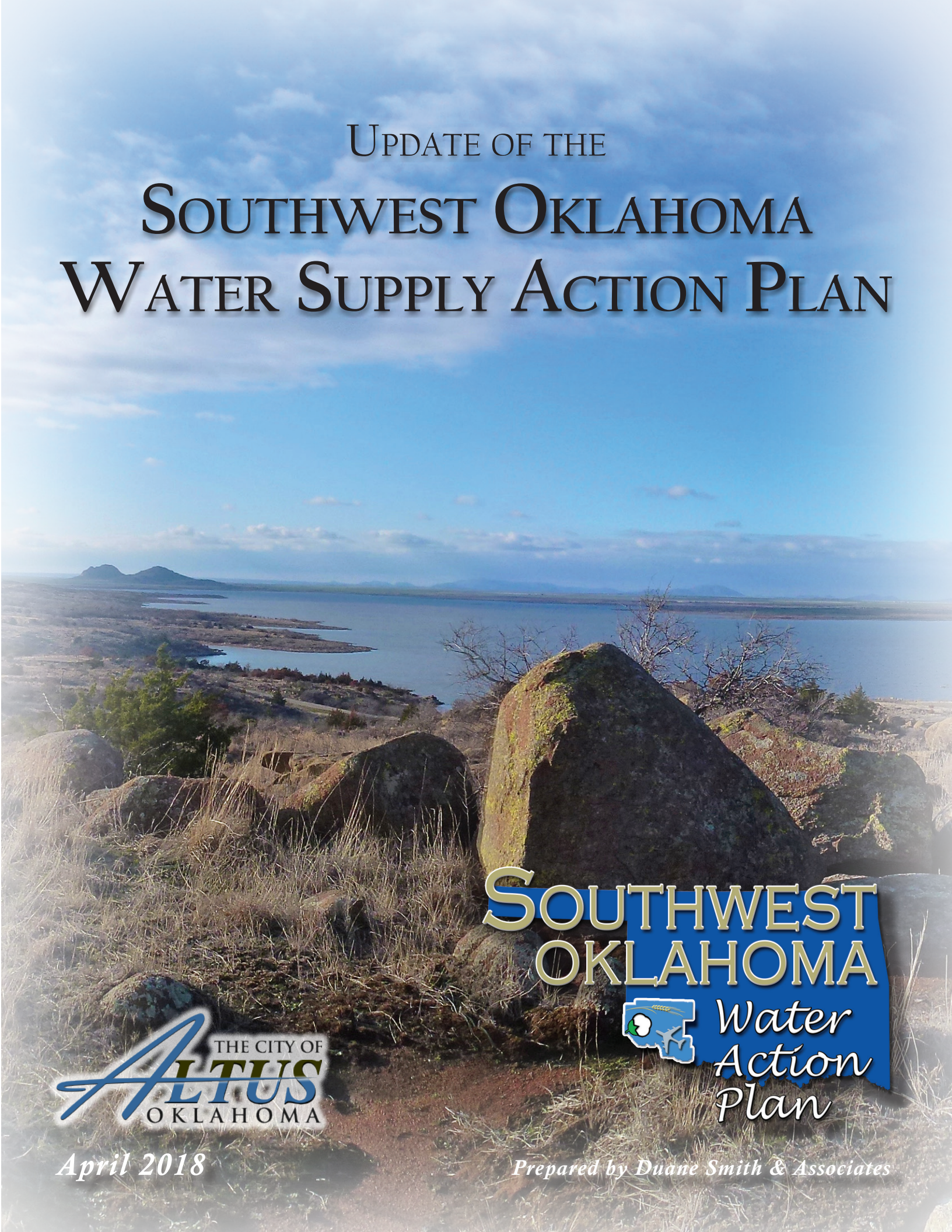

Update of the
Southwest Oklahoma Water Supply Action Plan

Southwest Oklahoma Water Action Plan

The City of Altus Oklahoma

April 2018

Prepared by Duane Smith & Associates

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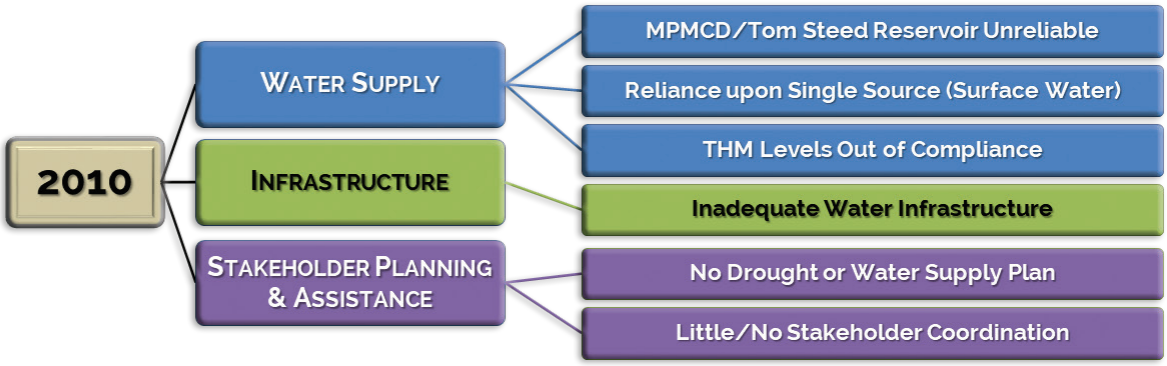
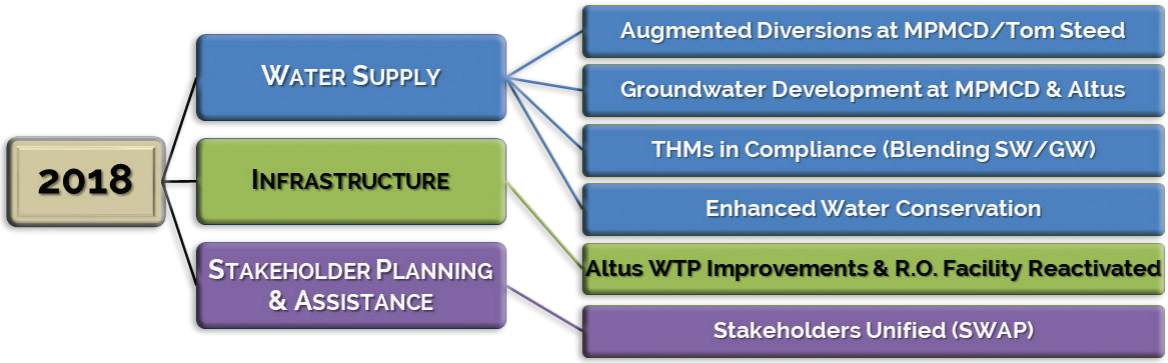
Evolution of the Southwest Oklahoma Water Supply Action Plan

From Then to Now... and Beyond

Unreliable Water Supply = Drought Vulnerability

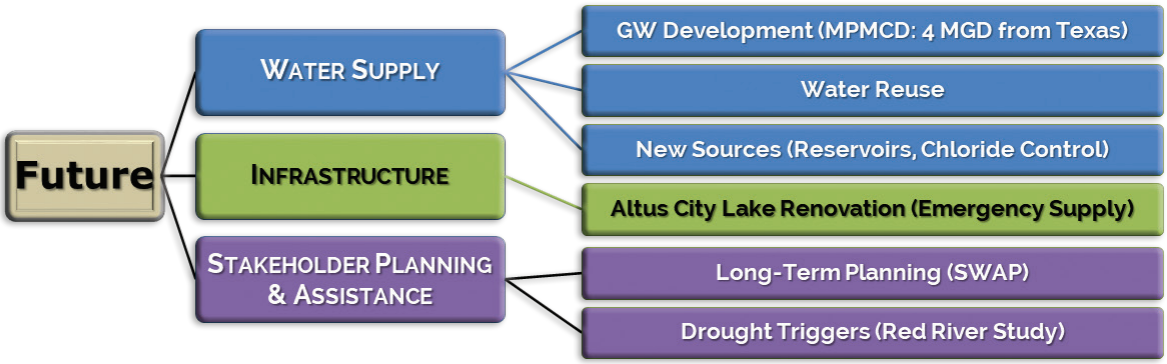
The regional situation at the onset of unprecedented five-year drought in southwest Oklahoma, leading to creation of the SWAP in 2014.





Implementation of near- and mid-term SWAP strategies provides new confidence in withstanding future droughts of similar magnitude.

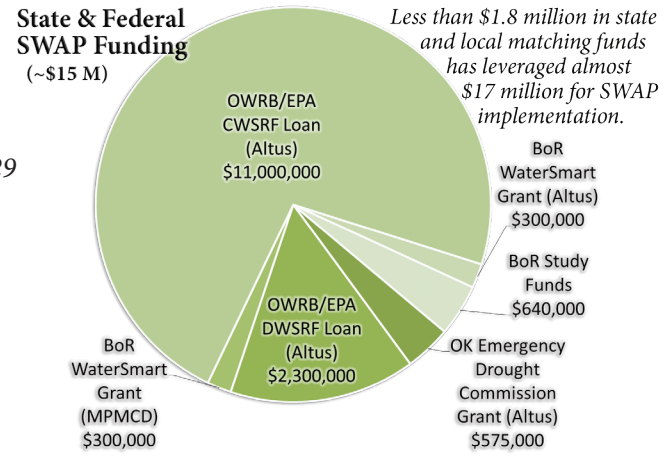
Continued SWAP implementation will absolutely minimize drought vulnerabilities and address a potentially drier climate ahead.



Reliable Water Supplies = Drought Resiliency

Leveraging Funds for SWAP Implementation

Maximizing available funding opportunities, SWAP partners have collectively secured $16,880,029 toward implementation of drought mitigation strategies in southwest Oklahoma—$1,765,029 in matching funds from the City of Altus, Mountain Park MCD and OWRB that has been used to leverage $15,115,000 in state and federal funding. This includes two OWRB Clean Water and Drinking Water State Revolving Fund loans—partially enabled through capitalization grants from the U.S. EPA—that will result in almost $2.3 million in subsidized interest rate savings (compared to market rates) over the lives of the loans.



Less than $1.8 million in state and local matching funds has leveraged almost $17 million for SWAP implementation.

Planning for Southwest Oklahoma's Water Future

Brian Bush, President & CEO, Altus Chamber of Commerce
& Dwayne Martin, Altus City Council

The drought of 2010-15 was a mighty powerful teacher for southwest Oklahomans.

No region of Oklahoma suffered as much or for so long from the statewide drought as the southwest. Beginning in the summer of 2010, lack of rainfall and runoff, rapid evaporation and increasing demand slowly and deliberately consumed our surface water supplies. For five years, progressively worsening precipitation deficits and resulting impacts extended throughout communities, industries and businesses in southwest Oklahoma.

To Mountain Park Master Conservancy District, which oversees Tom Steed Reservoir and service to some 40,000 customers in Altus, Frederick and Snyder.

To Jackson County Water Corporation, Quartz Mountain Water Authority, Creta Water Company and the towns of Duke, Blair, Olustee and Martha—all supplied by the City of Altus.

To Hackberry Flat Wildlife Management Area, a wetlands area created near Frederick in 1995, which provides 7,120 acres of wildlife recreational opportunities and relies upon supplemental water from Tom Steed.

To Lugert-Altus Irrigation District, so key to our region, where farmers were completely deprived of irrigation water for cotton, wheat and other crops as well as cattle.

To thousands of rural citizens without access to a water provider who were forced to abandon surface sources or drill new or deeper water wells for household supply.

In Altus, the ripple effect of the drought on the economy hit hard due to the failure of crops and loss of jobs, tax receipts and property taxes, which in turn impacted retail businesses, schools, health care, and the crucial maintenance of roads and other infrastructure.

But despite drought problems far and wide, we survived, due in large part to the strong foundation of our community established through the incredible foresight of past leaders. Altus Air Force Base, which provides 60 percent of the total employment in Altus, is a major part of this foundation, contributing about $8 billion to the area economy. Our cotton industry, already rebounding from its brief downturn, is the very backbone of this region, averaging some $200 million per year in crop production.

The Southwest Oklahoma Water Supply Action Plan (SWAP), developed under enormous pressure in the midst of the drought, also contributed to our survival. More importantly, it puts us in a stronger position moving forward. Completed in May 2014, this unprecedented plan, which is receiving national accolades, identifies realistic and implementable solutions to our drought problems, both now and in the future. Several priority mitigation projects are already complete, underway or nearing completion. Collectively, these drought mitigation strategies provide a much stronger foothold for our region's continued economic viability.

Still, the drought will—indeed it must—forever change the way we do business and live our lives in southwest Oklahoma. So what did we learn from this life-changing experience and the concurrent process leading to SWAP development?

First and foremost, we learned that water and its availability is an essential factor in our economy. Without it, we can no longer support agriculture. Altus and surrounding communities would cease to exist. Without a secure and reliable water source, our military could no longer fulfill its mission and responsibilities to our nation.

Major Employers in the Altus Area

Employer	Product/Service	Employees
Altus Air Force Base	Federal Installation	1507 Civilians 1410 Military 1743 Students
Jackson County Memorial Hospital	Medical Services	736 Full/Part-Time
Bar-S Foods	Processed Meats	640 Full/Part-Time
Altus Public Schools	Educational Services	425 (not including substitutes)
Walmart Super Center	Retail	300
City of Altus	Municipal Services	272 Full/Part-Time
Western Oklahoma State College	Educational Services	236 Full/Part-Time and Adjunct
Southwest Technology Center	Educational Services	44 Full-Time
Western Equipment	Agricultural Equipment Dealer & Training	43
United Supermarket	Retail	40
Turbines Inc.	Design & Manufacturing	23 Full-Time
Hobby Lobby	Retail	40+ (Opening February 2018)

Information courtesy of the Altus Southwest Economic Development Corporation, 2017

We've learned that our citizens and businesses cannot rely on a single source of water. When Tom Steed Reservoir was constructed, we believed it was the final solution to our water needs. Local groundwater supplies that the City had established in Texas were largely abandoned. We now know that Tom Steed is incapable of supplying the entire region and a broad and varied water supply portfolio is required to sustain us through similar droughts in the future.

The drought and SWAP also confirmed something that I already knew—Southwest Oklahomans are uniquely resourceful, particularly under difficult circumstances. And we are especially powerful when presenting a united front. As supplies dwindled and the emergency unfolded, Altus leaders and other stakeholders promptly came together to solve the problems and we identified experts and resources outside the region—consultants, state and federal water agencies, engineers, our leaders in Washington D.C.—possessing the experience and resources required to effectuate immediate solutions.

The planning, policy and engineering team of Duane Smith and Associates was especially valuable early on in facilitating meetings, compiling technical information and developing initial drought mitigation strategies. They continue to provide valued insight on emerging water issues and implementation strategies.

We leaned on the strong local/federal nexus in this region consisting of the Department of Defense—with military installations in Altus, Lawton and Wichita Falls, Texas—and Bureau of Reclamation, the agency responsible for the construction of numerous area projects, including Mountain Park/Tom Steed, Lugert-Altus Irrigation District and Foss and Fort Cobb Reservoirs. Today, many representatives of these diverse water interests serve on the permanent SWAP Advisory Team, which meets regularly to ensure timely implementation of Plan initiatives as well as influence the prioritization of water projects, studies, technical assistance and funding.

Already, we're reducing the pressure on Tom Steed through the establishment of multiple sources, especially groundwater, which is widely available in surrounding areas. Both the City of Altus and Mountain Park MCD are tapping new sources of groundwater—or, in the case of wells in Texas, historic sources—to supplement surface supplies. It is believed that, in the near future, Mountain Park will be able to meet at least moderate drought demands through groundwater alone.

Improved management of the Bretch diversion, which channels water to Tom Steed, is already paying tremendous dividends. The additional water currently flowing into the lake (estimated at 21,000 acre-feet per year) essentially cancels out the amount of water lost from the lake each year due to evaporation.

Improvements have been made at the Altus Water Treatment Plant to make operations more flexible, increasing the efficiency of treatment and distribution of blended water sources. As a result, the character of our supplies is improving not only in Altus proper, but also at the Air Force Base, where quality was once considered among the five lowest of U.S. military installations but is now rated in the top 10.

These infrastructure upgrades, enabled primarily through millions of dollars in funding from our state and federal partners and leveraged funds, include new smart meters that will help Altus better account for water usage, provide for more accurate customer billing and reduce wasteful leaks.

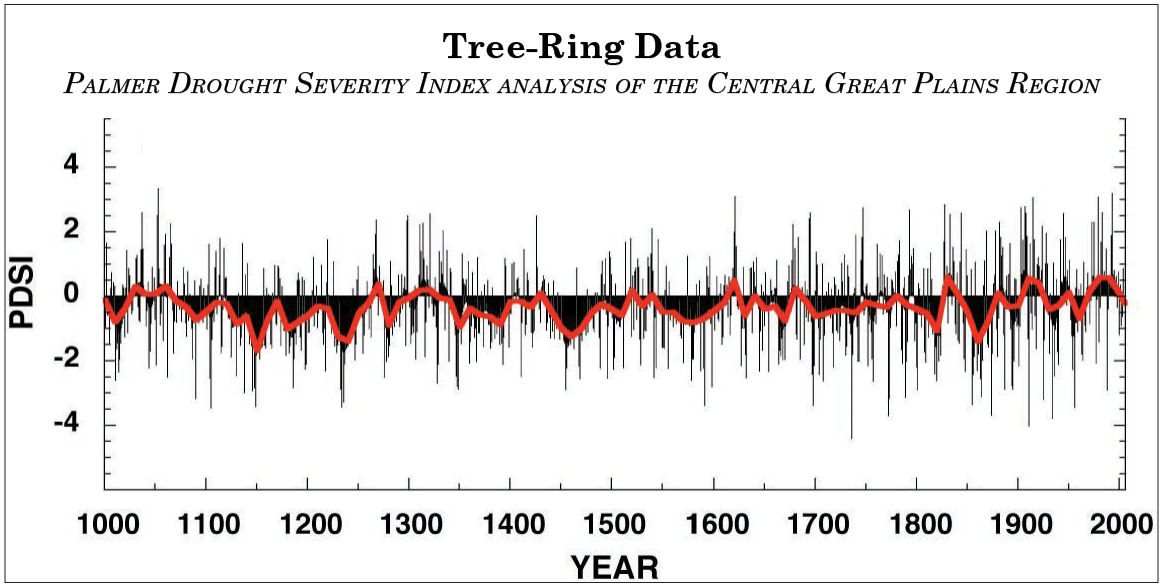
On the technical side, through the Bureau of Reclamation's Upper Red River Basin Study, a draft of which is expected later in 2018, we will soon learn how future climate variability and reduced precipitation could impact available water supply at Tom Steed and Lugert-Altus Reservoirs. Sedimentation and upstream water withdrawals also present numerous challenges in realizing the full potential of both lakes, including essential

SWAP Task Force Meeting

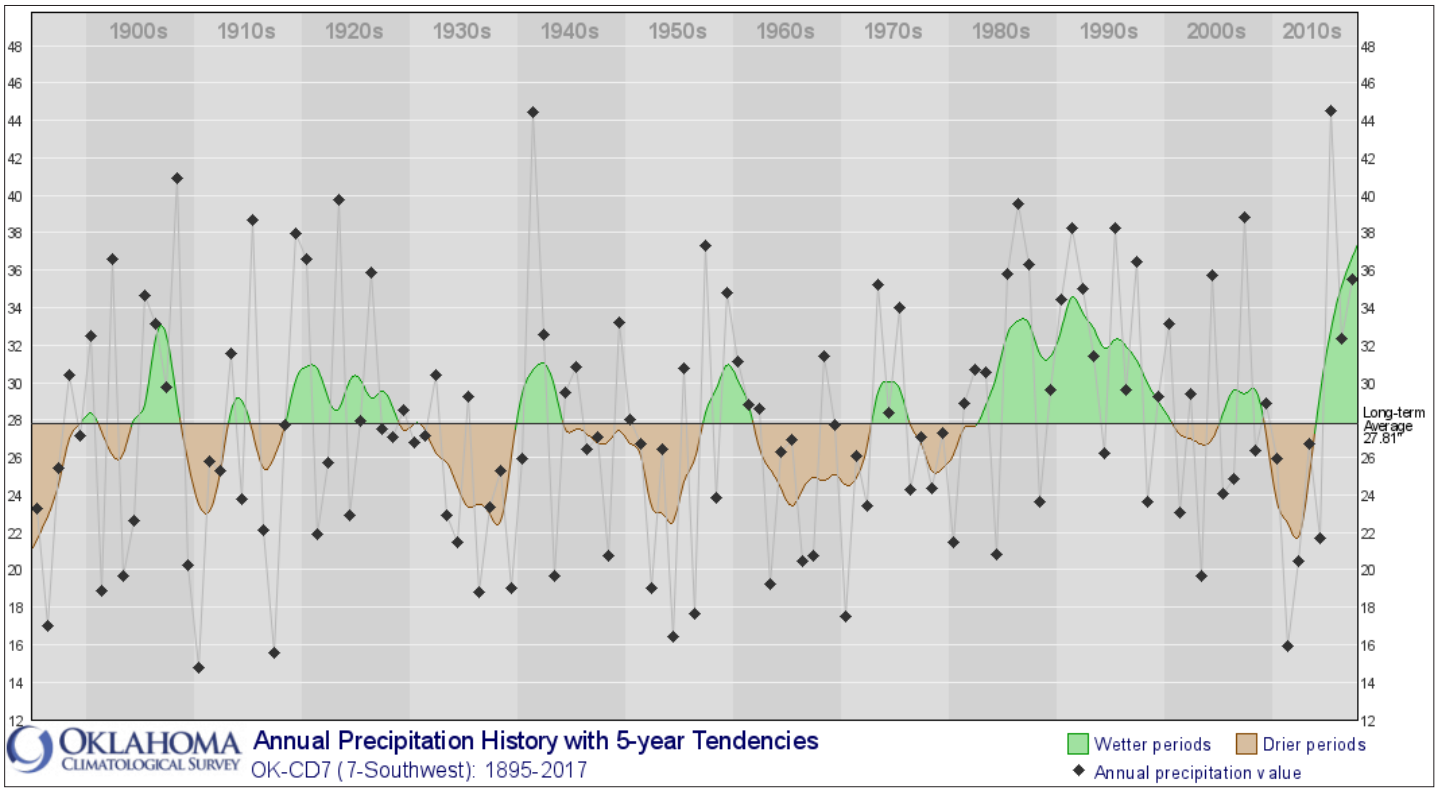
ecological, recreational and related economic benefits. The study will identify possible solutions to enhance water reliability, including evaluations of the potential Cable Mountain Reservoir project and planned structure modifications to the Bretch diversion.

Speaking of climate, perhaps the most impactful lesson we've learned so far is that our region must prepare itself for a drier water future. Data indicate that, since at least the 1980s, we've experienced very favorable precipitation patterns. Believe it or not, even semi-arid southwest Oklahoma has been abnormally wet over much of the past 30-plus years. While many of our citizens can remember extended drought episodes during the 40s, 50s and 60s, the experience of younger residents is filled with lush, green vegetation and only occasional, short-lived water problems. This results in a perilous false sense of security, especially related to water availability. It is quite possible that the 2010-15 drought wasn't an abnormality at all and could be an indicator that our region, in fact, is returning to "normal." In any case, this possibility is what we have planned for as an integral aspect of SWAP.

We've also learned that water is generally undervalued by consumers, especially compared to other basic utilities, such as electricity or natural gas. Each of us could "survive" a couple days without our phones. Try doing that with no water. And remember, the cost of getting



Tree-ring analyses indicate that the Great Plains Region, including southwest Oklahoma, has experienced frequent drought episodes since at least 1000 A.D.



Annual precipitation, Southwest Oklahoma (1895-2017)

water to the tap also includes the infrastructure required to treat and deliver it, which is considerable.

We must focus on water conservation and eliminate all forms of waste. Our local irrigators and agricultural producers have implemented numerous measures to capture, use and reuse every available drop, and they're working with the Natural Resources Conservation Service and other federal agencies to implement prescribed water and soil conservation practices on their lands. At the municipal and industrial level, we're revisiting plans and strategies to improve efficiencies and reduce water waste. A new, more flexible conservation ordinance will soon be implemented in Altus.

So while all of these proactive measures will allow us to withstand simlar drought disasters in the future, our vigilance and planning can never cease. More work remains to prepare us for longer and/or more severe drought episodes.

Phased SWAP Strategies & Projects

Near-Term

Additional Groundwater Supplies	Additional Water Conservation	Unified Drought Response Plan	SWAP Advisory Committee
City of Altus *Mountain Park MCD* *Hydrologic Studies*	*City of Altus*	*Modeling & Regional Drought Triggers*	

Mid-Term

Lake Rehabilitation	Non-Potable Reuse	Additional Water Diversion	Interconnection of Distribution Systems
City of Altus			

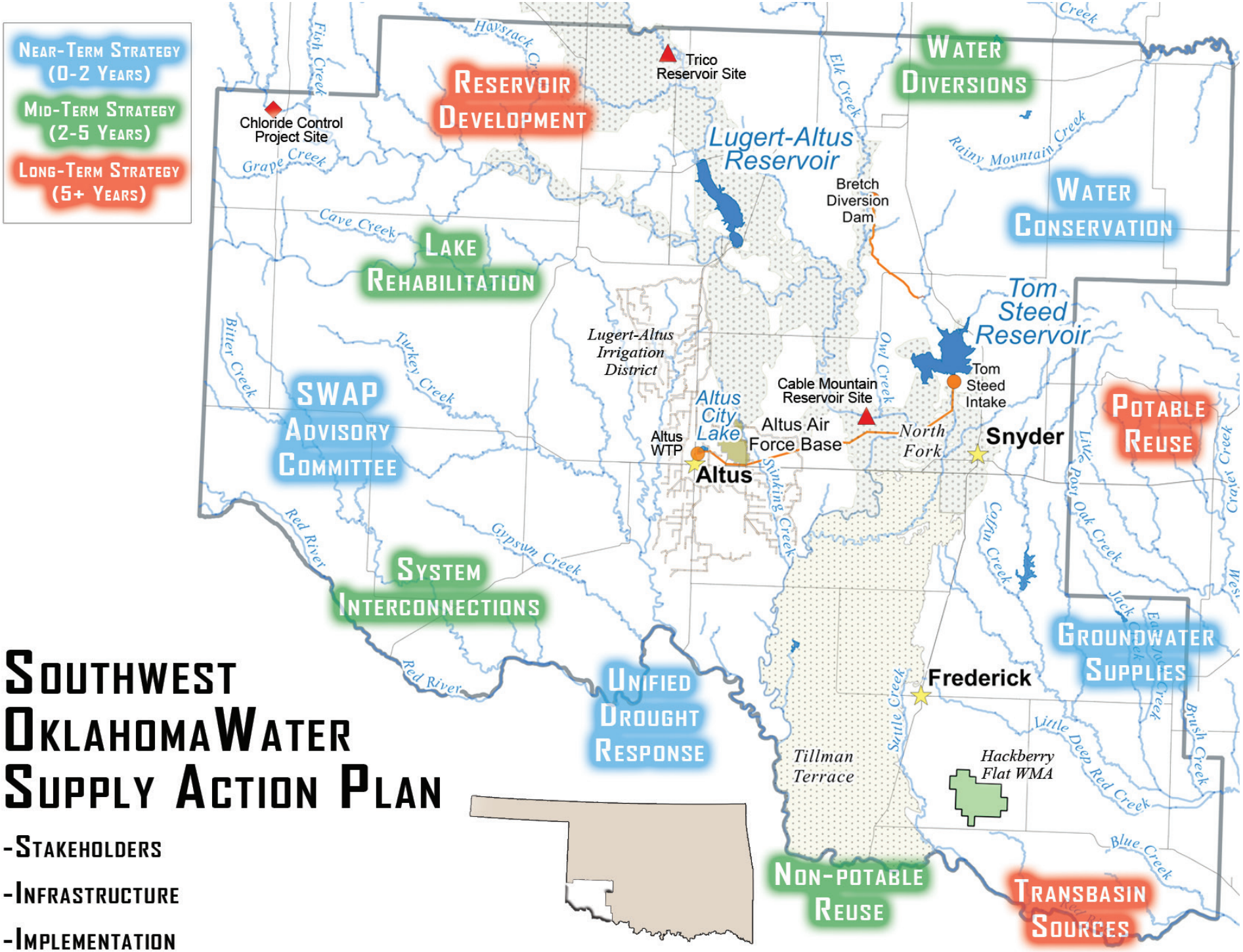
Long-Term

New or Expanded Reservoir Development	Potable Reuse	New Transbasin Sources
Cable Mountain Reservoir *Trico Reservoir* *Chloride Control*		

SWAP stakeholders will continue to enhance their water reliability and broaden and balance supply portfolios. There are plans to renovate Altus Reservoir and bring the old treatment plant back into the fold while beautifying the lake area and opening it up to new commercial development. SWAP also contemplates the use of marginal quality sources, such as reclaimed wastewater, that can be used in place of potable water supplies. And we've identified potential reservoir sites that could one day provide beneficial supply to our growing number of water users, including agriculture.

We're achieving wide-ranging support for these and other SWAP implementation projects through our federal and state drought partners, including the Western Federal Agencies Support Team, National Drought Resilience Partnership and Oklahoma Water Resources Board. More than a dozen agencies are currently collaborating with SWAP Task Force representatives in a southwest Oklahoma regional drought resilience demonstration project. We'll be focusing on opportunities to leverage available government resources—both technical and financial—for the benefit of SWAP partners. In turn, it is envisioned that successful implementation of collaborative drought strategies can be replicated elsewhere in the U.S.

Following up on the initial Plan in 2014 and Interim Update in 2015, the subsequent pages of this most recent SWAP update present the current status of implementation strategies and projects to augment and sustain southwest Oklahoma water supplies. Additional background, including maps and graphics, are available in those previous reports.



Southwest Oklahoma Water Supply Action Plan

- Stakeholders
- Infrastructure
- Implementation

Near-Term Implementation

Strategy — Additional Groundwater Supplies

A primary goal of SWAP is enabling water providers to achieve a better balance of supply portfolios especially through the addition of groundwater, which is much more prevalent in the region and generally more dependable than surface sources. In addition, the blending of surface and groundwater supplies can help to address the prevalent problem associated with excess trihalomethanes (THMs) in the local drinking water supplies. [THMs are potentially harmful disinfection by-products that occur when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter.] Both the City of Altus and Mountain Park Master Conservancy District have been extremely proactive in implementing this particular solution.

On the state level, SWAP participants are working with the Oklahoma Water Resources Board (OWRB) to update studies of minor groundwater basins in southwest Oklahoma that could augment current supplies.

Project — City of Altus

The City of Altus utilized a $2.3 million State Drinking Water State Revolving Fund loan in conjunction with a $575,000 Emergency Drought Relief Grant to develop additional wells and infrastructure to bring up to one million gallons per day (MGD) of groundwater into the municipal system. Intended to reduce the City's dependence on Tom Steed and provide supply redundancy, this vitally important project includes reactivation of wells in Texas—the Round Timber and Holloway well fields south of the Red River near Vernon that were established in the 1960s but abandoned when Tom Steed Reservoir came on line. The City recently settled a lawsuit over these water rights and a parallel 12-inch water line has been added to the existing 18-inch line to access the water. The new pipeline—parallel to the City's existing line—allows Altus to increase its capacity to supply neighboring customers, including Creta Water Corporation and the Town of Olustee. Blending of surface and groundwater sources will also reduce excess THMs in the City's drinking supply and reduce treatment costs. Additional future groundwater development is planned by the City in the Tillman Terrace aquifer, southeast of Altus. The City recently entered into an agreement to buy water from a landowner of an existing well field and it has purchased land and water rights in Wilbarger County, Texas.

The City of Altus has also brought its existing reverse osmosis (RO) water treatment plant back on line to provide for future treatment of groundwater supplies, facilitate more flexibility in its ability to treat water from Lugert-Altus Reservoir (when required, as during drought and related emergencies), and address THM concerns. Due to significant water losses (i.e., low treated water recovery rates), high operating costs and related issues, the RO facility was taken off line in 2011. The facility has been redesigned and retrofitted to accommodate conventional (rather than current ultra-filtration) pretreatment technology, thus reducing operating costs. The City is now in compliance with THM standards.

Status	Funding
The Round Timber and Holloway (Texas) wellfields have been brought online.	$575,000 grant (OK Emergency Drought Relief Commission, March 2014)
The parallel water line is complete and in service.	$2.3 million loan (OWRB DWSRF, March 2015)
The RO plant is back online (2016).	$8 million total project cost

Near-Term Implementation

Strategy: Additional Groundwater Supplies

Project: Mountain Park Master Conservancy District

Bringing available groundwater into the system will allow Mountain Park MCD to directly augment supply in Tom Steed Reservoir and increase water delivery capacity to customers while establishing a vital emergency drought supply for customers. In 2014, MPMCD members pooled resources to sponsor a geologic study and the drilling of test holes just downstream of Tom Steed dam to identify potential well sites of suitable quantity and quality. In June 2017, $300,000 was awarded to the District through the Bureau of Reclamation's Drought Response Program to complete the initial phase of this groundwater augmentation project. The water will be distributed directly to Altus and/or Snyder through existing raw water lines. As with Altus, blending of supplies will also help mitigate THM issues. Including future wells in Texas, this project will eventually add 4 MGD to the District's water supply portfolio—equal to the average demand experienced during the 2010-15 drought.

MPMCD is also planning to initiate formal discussions with Corps of Engineers officials to investigate the potential for adjusting Tom Steed's existing water control plan to allow for more flexibility in releasing flood storage, such as through a seasonal pool plan or related strategy.

Status	Funding
Anticipated project completion by December 2018.	Phase 1 = $300,000 cost-share grant (BoR WaterSMART Drought Response Program, June 2017); $318,500 District Funds Phase 1/2 = $1.2 million (MPMCD Members)

Strategy: Additional Groundwater Supplies

Project: Hydrologic Studies

SWAP participants are currently cooperating with OWRB officials and staff to heighten the priority of planned hydrologic studies of key minor aquifers in southwest Oklahoma that could potentially serve as future sources of local groundwater supply. While state law requires that recognized major and minor groundwater basins and their associated maximum annual yields be studied and updated at least every 20 years, a major backlog exists. Insufficient and mostly unreliable information is currently available on these minor, yet potentially valuable, groundwater supplies.

Status	Funding
Consultation with OWRB and subsequent basin update commitment anticipated by December 2018.	N/A

Near-Term Implementation

Strategy — Additional Water Conservation

Both voluntary and mandatory conservation measures have the potential to delay or even eliminate ongoing drought impacts. But SWAP stakeholders also recognize that consistent conservation strategies—rather than temporary measures—must be integrated into future local/regional water supply management schemes, especially in light of an anticipated warmer and drier climate. During the 2010-15 drought, Mountain Park MCD customers voluntarily reduced usage by some 40 percent in response to critical lake level declines while Altus enforced Stage 3 conservation provisions that preclude lawn watering, mandate the closing of car washes one day each week and other aggressive measures to preserve limited supplies. Before the drought, the City's maximum demand was 10-11 MGD. Today, with conservation and water use changes, it's been reduced to 8-9 MGD; at least 4 MGD is the average demand. The City's capacity is 16 MGD. Both civilian and military residents at Altus Air Force Base (AFB), who consume a majority of the City's water supply, have demonstrated exemplary water use habits in adhering to the municipality's conservation ordinance; the Base has even developed some non-potable sources of water. Federal laws require the nation's AFBs to possess at least 14 days of self-sustaining water supply.

Recognizing the considerable water challenges facing agricultural producers—including accelerated sedimentation of Lugert-Altus Reservoir—Lugert-Altus Irrigation District (LAID) members have taken aggressive action to increase the accounting and efficiency of water use and improve delivery systems. Today, about 90 efficient drip irrigation systems provide water to 11,500 acres of District land, with 10 additional systems added annually. In addition, members have established 64 tailwater pits that catch and retain runoff from almost 12,000 acres of cotton fields. On an additional 4,500 acres, 36 pumps have been installed to catch water that escapes the fields for reuse. Collectively, these measures virtually eliminate waste as irrigators use 100 percent of the water delivered to their fields. Efficient usage of Lugert-Altus Reservoir by District members not only extends the life of the water source, it alleviates potential supply problems elsewhere in the region.

LAID farmers and other irrigators in the region are also actively cooperating with local Natural Resources Conservation Service (NRCS) staff to invest in conservation practices on their lands. Through the agency's Environmental Quality Incentives Program (EQIP) and Agriculture Water Enhancement Program (AWEP), in Jackson County alone, many thousands of irrigated acres (more than 6,000 acres in 2010-11) were enrolled in these programs during the drought, establishing efficient irrigation systems that more uniformly apply water and chemicals without excessive water loss, erosion or salt accumulation.

Project — City of Altus

Utilizing a portion of an OWRB loan recently awarded to fund wastewater infrastructure improvements, the City has begun replacing thousands of existing water meters with smart meters. This will not only improve accounting and control of water use, it will help pinpoint problem areas in the distribution system, thus reducing the amount of water lost to leakage and related issues. It is estimated that Altus previously lost about 37 percent of its water to leaks. The City is also currently working to restructure water utility rates to enhance conservation while maintaining municipal revenues that help fund required water/sewer infrastructure maintenance and upgrades.

On March 13, 2018, City officials enacted a new, more agressive conservation ordinance that incorporates recent supply and infrastructure improvements and establishes more exacting drought stage triggers for water restrictions tied to water use/demand, supply levels, regional drought indices (including the National Drought Monitor) and seasonal climate forecasts. A fundamental change establishes permanent basic water conservation measures for city residents

Status	Funding
Municipal water rates restructured in July 2016. New municipal conservation ordinance approved March 2018.	$11 million loan for municipal wastewater improvements—portion for smart meter replacement (OWRB CWSRF, November 2017)

Near-Term Implementation

Strategy: Unified Drought Response Plan

Future drought response and conservation planning must be regionally-focused and require consistency between users of shared supplies, culminating in a unified drought response plan for the region that will make all water systems and customers more drought resistant.

Project: Modeling & Regional Drought Triggers

Through the $1.7 million Upper Red River Basin Study—a collaboration between Reclamation, the OWRB, Mountain Park MCD and Lugert-Altus Irrigation District—Reclamation is evaluating multiple scenarios and solutions that will improve the supply reliability of Tom Steed and Lugert-Altus Reservoirs. Reclamation's computer model will include various ranges of future water demands, precipitation/runoff/inflow, upstream uses and diversions, surface water rights, potential water transfers and related factors impacting availability. This information can then be used by stakeholders to guide future water management/development decisions as well as establish appropriate "triggers" for the implementation of phased drought stages—such as 1) Watch, 2) Alert, 3) Warning and 4) Emergency—for individual or shared water supply providers and/or the region. the draft of which is expected in Fall 2018.

Status	Funding
Draft study model anticipated in Fall 2018.	$1.7 million (BoR, OWRB, Districts)

Strategy: SWAP Advisory Committee

The permanent SWAP Advisory Committee meets bimonthly to ensure implementation of SWAP and adjust initiatives, as necessary, to meet constantly evolving water supply issues and challenges. The Committee also provides a strong representative body through which to promote regional initiatives and coordinate directly with state and federal agencies and organizations.

Currently at the forefront of issues, especially in Altus and at the AFB, are THMs. Both the City and AFB are closely monitoring THMs to gage anticipated improvements resulting from the blending of new supplies. The AFB's 97th Medical Operations Squadron bioengineering flight routinely conducts water sampling to monitor drinking water for these and other potential contaminants. The AFB is also currently replacing all water lines at the installation to provide for a more reliable and secure supply.

SWAP participants successfully lobbied the Bureau of Reclamation for a detailed study of the Upper Red River Basin that will address how climate risks may affect future water supply, demand and operations in the basin. The study will also identify adaptation strategies that will allow southwest Oklahoma water users to become more resilient to future drought episodes.

Status	Funding
N/A	N/A

Mid-Term Implementation

Strategy: Lake Rehabilitation

Altus City Reservoir, historically replenished by Lugert-Altus Reservoir by means of an irrigation canal, served as the city's primary source of water up to 1975 when Altus turned to Tom Steed. Now abandoned for decades, the municipal lake suffers from significant accumulation of sediment and high levels of minerals and salinity, promoting the growth of golden algae and greatly increasing treatment costs.

However, once rehabilitated, Altus' 140-acre municipal reservoir has potential to greatly improve the City's resiliency to future drought episodes, create a convenient and redundant water source, and alleviate pressure on other regional surface sources. It is estimated that rehabilitation would effectively create an emergency 45-day supply of water as well as establish a contingency source should there be a service disruption at Tom Steed, such as that required due to line maintenance.

Project: City of Altus

Plans for the estimated $647,000 project call for hydraulically isolating the reservoir's east basin (the west basin is extremely shallow, about seven feet at maximum depth) and supplementing its supply with about 115 million gallons of Tom Steed water. The proposed project includes tapping the City's existing 36-inch raw water line will be utilized along with construction of 2,385 feet of new 30-inch water line to feed raw water into the northeast corner of the east basin. In addition, the old pump station will be rehabilitated, including replacement of the pump and controls and upgrading of the electrical system. The result of the project will be a continuous flow of Tom Steed water through the east basin and continuous withdrawal of water for treatment. Project planning, design and implementation also includes pursuit of a venture to enhance recreation and commercial investment around Altus Reservoir for Altus citizens, AFB military personnel and their families. In September 2016, the Bureau of Reclamation approved $300,000 in matching funding through the WaterSMART Drought Resiliency Grant Program.

Status	Funding
Construction pending. Anticipated completion by September 30, 2018.	$300,000 cost-share grant (BoR WaterSMART Drought Resiliency Program, September 2016); $346,529 in City funds.

Strategy: Non-Potable Reuse

This strategy involves the use of treated wastewater from the City of Altus for selected irrigation and industrial applications--i.e., "indirect" uses--although opportunities might also exist for intergovernmental cooperation to facilitate the use of reclaimed wastewater at Altus Air Force Base. In its 2005 report ("Appraisal Report, Water Supply Augmentation, W.C. Austin Project, Oklahoma"), the Bureau of Reclamation investigated several options to augment supply in Lugert-Altus Reservoir. BoR identified the reuse of up to 3 MGD of Altus' municipal wastewater for supplemental irrigation use by the Lugert-Altus Irrigation District. The City currently discharges about 2 MGD from its wastewater plant. Irrigation, industrial and other non-potable reuse applications must be consistent with Oklahoma Department of Environmental Quality (ODEQ) regulations. Aside from irrigation of municipal properties, including the golf course, reclaimed water could be of value by the LAID and/or Hackberry Flat WMA. New rules governing treatment of reclaimed water for indirect municipal use are under consideration by the Oklahoma Department of Environmental Quality, with potential approval as soon as September 2018.

Status	Funding
N/A	N/A

Mid-Term Implementation

Strategy: Additional Water Diversions

Mountain Park MCD officials have long contended that additional creek diversions are required to supplement supply at Tom Steed Reservoir and provide essential supply reliability for customers. The Bretch Diversion Dam (on Elk Creek in Kiowa County) and Canal diverts and conveys Elk Creek flow into the watershed upstream from Mountain Park Dam to supplement the natural flow of West Otter Creek. Recent improvements in the management of diversion infrastructure have resulted in approximately 21,000 acre-feet/year of additional water for Mountain Park water users, including the City of Altus and their customers. This essentially offsets the total amount of the substantial evaporative losses experienced each year at Tom Steed Reservoir.

Project: Mountain Park Master Conservancy District

Through the Upper Red River Basin Study, anticipated for completion in Fall 2018, the Bureau of Reclamation is investigating the anticipated benefits of widening the existing Bretch Diversion Canal and thus diverting even more flows, when available, from Elk Creek to the lake. District staff will work closely with BoR officials to review results of the investigation and accelerate implementation of an appropriate diversion augmentation project.

Status	Funding
Consultations with Reclamation by December 2018	Included under Upper Red River Basin Study.

Strategy: Interconnection of Distribution Systems

Several existing and/or future interconnections to facilitate emergency and/or regular supply sharing between municipal, rural and/or military water systems in the southwest region are under consideration by SWAP stakeholders. Enhancing connectivity will provide diversity in supply sources and strengthen reliability while experiences from the 2010-15 drought will provide valuable guidance in selecting the most promising management and delivery schemes. Extension of service and improved water quality to Creta Water Corporation and the Town of Olustee are being achieved through reactivation of the Round Timber wellfield by the City of Altus. Altus AFB officials have expressed an interest to explore interconnection options in establishing a redundant water supply source specifically for the Base.

Status	Funding
N/A	N/A

Strategy: New or Expanded Reservoir Development

This strategy includes the addition of new water sources through the modification and/or development of current or potential reservoir sites. Existing sites include dams constructed by the Natural Resources Conservation Service (NRCS) and the Lugert-Altus and Tom Steed projects. Potential projects under consideration include Cable Mountain (along with its companion chloride control project) and Trico. All of these potential options will require significant study, time and guidance from federal agencies, beginning with initial evaluation of potential sites. Funding requirements will also be considerable.

Project: Cable Mountain Reservoir

In its 2005 appraisal report of water supply alternatives that could reduce the irrigation demand on Lugert-Altus Reservoir, the Bureau of Reclamation evaluated the previously studied Cable Mountain Reservoir site. This potential project, just east of District land on the North Fork of the Red River, would operate independently of Lugert-Altus Reservoir, which exists some 40 miles upstream.

The Cable Mountain project would require a pumping plant, pipeline and canal to convey water to the existing irrigation system as well as chloride control measures upstream to render the water suitable for irrigation use. The estimated yield of Cable Mountain Reservoir is substantial—between 100,000 and 120,000 acre-feet per year (AFY)—and the lake could also serve as a source of public water supply for users in the region, including the City of Altus and AFB, Wichita Falls and nearby Sheppard AFB as well as other military installations in the area.

As part of the Upper Red River Basin Study, Reclamation is performing a hydrologic analysis of the proposed reservoir site as well as updated costs. Draft capital and annual O&M costs (preliminary-level)—excluding chloride control—are estimated to be $400 million and $2.1 million, respectively (2016 dollars). Preliminary data suggest that the 100% dependable yield of Cable Mountain could be 27,800 ac-ft/yr and the 20% dependable yield could be 211,000 ac-ft/yr. The draft annualized life-cycle costs range from $670 to $88 per acre-foot, respectively.

SWAP members have initiated early communications with Reclamation staff on the Cable Mountain project. Up to $200,000 in federal funds is available to conduct a detailed engineering study of the site, as well as the Bretch Diversion canal project. Members are working with BoR to accelerate investigation of both projects.

Status	Funding
Secure initial project study funding by December 2018. Ongoing discussions with Oklahoma Congressional delegation and D.C. representatives.	N/A

Strategy: New or Expanded Reservoir Development

Project: Trico Reservoir

In its 2005 appraisal, Reclamation also identified the Trico (Tri-County) Reservoir site, on the North Fork about 10 miles upstream of Lugert-Altus Reservoir, as a potential water supply augmentation option for the District. The project's yield, which would meet seasonal irrigation needs, is estimated to be between 30,000 and 35,000 AFY. Trico Reservoir would also serve to trap sediment, which currently negatively impacts storage capacity at Lugert-Altus Reservoir. Reclamation estimated that the project would cost as much as $440 million with up to $330,000 in annual operation and maintenance (2004 cost basis).

Status	Funding
N/A	N/A

Long-Term Implementation

Strategy: New or Expanded Reservoir Development

Project: Chloride Control

The Cable Mountain Reservoir project is contingent upon implementation of a companion chloride control project to control the contribution of some 510 tons of natural salts from the Elm Fork tributary of the North Fork near the Harmon/Beckham County border. While the Corps of Engineers has investigated the problem for more than half a century and the Elm Fork and related projects in the Oklahoma-Texas region have been economically justified, no funding is currently available for implementation. However, previous concerns about the downstream environmental impacts of the Elm Fork project—including that on Lake Texoma's striped bass fishery—have been alleviated somewhat. According to a 2012 Corps of Engineers report ("Area VI Red River Chloride Control Project, Phase III Report), a group of experts concluded that chloride management is not anticipated to have a measurable effect on the adult striped bass population in Lake Texoma, but they were less certain about the longer-term impacts.

An important facet of the Cable Mountain/Elm Fork chloride control project is that it would provide benefits many years in advance of the reservoir's construction by reducing the salt content of contributing drainage to Lugert-Altus Reservoir.

Status	Funding
N/A	N/A

Strategy: Potable Reuse

Potable reuse of treated effluent to augment existing sources for drinking water supplies—especially of an indirect nature utilizing an environmental buffer—remains under consideration. This technology could augment Tom Steed and/or Lugert-Altus Reservoir with reclaimed water or be implemented through groundwater recharge. Direct potable reuse, which typically features a water reclamation plant and advanced water treatment before distribution, is generally a more long-term measure but the technology is gaining wider acceptance throughout drier regions of the country. A SWAP Task Force member is currently serving on an ODEQ committee that is formulating the first state regulations to govern potable reuse in Oklahoma.

Status	Funding
N/A	N/A

Strategy: New Transbasin Sources

The pursuit of new transbasin water supplies remains only a long-term solution due to the significant costs and political obstacles typically associated with such projects. It is anticipated that successful implementation of other SWAP strategies will allow the region to satisfy its currently identified future water needs.

Status	Funding
N/A	N/A

The Western Federal Agency Support Team and National Drought Resilience Partnership: Supporting SWAP Implementation

The SWAP's success to date has garnered national attention that will further enhance efforts to implement the Plan and strengthen southwest Oklahoma's future drought resilience. In 2016, the Oklahoma Water Resources Board reached out to the National Drought Resilience Partnership (NDRP) through the Western Federal Agency Support Team (WestFAST) to request that the Southwest Oklahoma region be included in a drought resilience demonstration/collaboration project initially focusing on opportunities to leverage available federal resources—both technical and financial—for the benefit of SWAP partners.

The NDRP was formally established in 2016 to ensure that federal agencies worked better together in support of locally driven, long-term drought resilience and build national capabilities that complement state, regional, tribal and local drought preparedness, planning and implementation efforts. Originally established to support the Western States Water Council (WSWC) and Western Governors Association, WestFAST is a collaboration between 12 federal government agencies to coordinate and maximize federal water-related efforts on the state and local level in the western U.S.

While WestFAST and NDRP officials identify measures through which the federal government can enhance SWAP implementation, the ultimate goal is to apply the SWAP model to other regions and states in mitigating their own droughts and building long–term drought resilience and water supply reliability. The Southwest Oklahoma Water Summit, a pivotal meeting in SWAP's federal collaboration effort, was held in August 2017 at Western Oklahoma State College in Altus.

The Summit provided a forum for comprehensive discussion of water and drought issues facing the region, and it allowed NDRP and WestFAST members—as well as officials from the OWRB and other state agencies—an opportunity to view first-hand local municipal and agricultural water supplies, including treatment and distribution infrastructure. In-depth discussions were held over two days, including all five major stakeholder groups—the City of Altus/Chamber, Altus Air Force Base, Mountain Park Master Conservancy District, Agriculture/Industry/Business, and Lugert-Altus Irrigation District. The Summit resulted in identification of eight distinct action areas, largely consistent with primary SWAP initiatives, on which to focus future federal assistance. A federal lead was appointed to each area to serve as a point of contact and assist the local and state stakeholders in coordinating with other federal agencies. Associated deliverables are included with each action area.

SWAP Water Summit, Western Oklahoma State College, Altus (August 2017)

Action areas include:

1. Altus Reservoir Rehabilitation: Improving and rehabilitating the historic Altus Reservoir so that it will be capable of storing at least 30-45 days of emergency water supply. There are several options for augmented supply to the City lake, including excess flows from upstream reservoirs, captured local rainwater, groundwater sources and, if feasible, recycled water. The City lake also holds significant opportunity for commercial and recreational development.
2. Water Reuse and Recycling: Identifying opportunities for potentially using highly-treated municipal effluent from the Altus municipal wastewater treatment plant and identifying opportunities for treating and using potential groundwater sources.
3. New Groundwater Sources: Identifying potential sources of groundwater that could be used as alternative supplies during times of drought and water scarcity.
4. Administrative Water Reliability: Reclamation continues collaborating with the OWRB and water districts—using technical assistance from USGS—to develop surface and ground water models and evaluate impacts and solutions associated with the management of water rights in basins that affect Tom Steed and Lugert-Altus Reservoirs.
5. Irrigation Efficiencies: Working with local landowners and growers to deploy the most efficient irrigation systems possible and continue to educate farmers on the use of cover crops and no till to enhance soil health and improved water efficiency.
6. Reservoir Development/Enhancement: Identify any potential lessons learned from other federally owned and/or operated reservoirs that could be incorporated by SWAP initiatives.
7. Altus Municipal Water System Enhancements: Where needed, assist in development of robust asset and utility management; enhancement of water efficiency and conservation; and improved water loss auditing and control as well as more accurate billing.
8. Regional and Statewide Drought Contingency Planning (National Integrated Drought Information System, NIDIS): Support identified drought contingency planning needs.

WestFAST is in the process of developing a companion document to the SWAP that will identify lessons learned and specific methods to foster the ability to replicate this work in other states and/or regions or basins.

National Drought Resilience Partnership

The NDRP Framework emphasizes improvements in federal agency collaboration to ensure more efficient use of program dollars and agency expertise in building national capabilities for long-term drought resilience.

Strategies:

- Strengthening coordination of federal drought policies and programs in support of state, tribal, and community efforts;
- Serving as a single federal point of contact on drought resilience;
- Leveraging the work of existing federal investments such as the National Integrated Drought Information System (NIDIS), the development of a National Soil Moisture Network, and the Bureau of Reclamation-Natural Resource Conservation Service partnership to improve agricultural water use efficiencies; and
- Linking information, such as monitoring, forecasts, outlooks, and early warnings, with long-term drought resilience strategies in critical sectors, such as agriculture, municipal water systems, energy, recreation and manufacturing.

Partnerships:

- Data Integration and Collection... support Federal, state, and local data collection and distribution efforts;
- Preparedness, Mitigation, and Risk Management... supporting regional state, local, and tribal preparedness and planning;
- Actionable, Science-Based Information and Tools... converting data into knowledge for timely and informed decision-making;
- Sustainable Water Infrastructure... managing resources for a more secure water future;
- Managing Lands & Waters... resilient farms, ranches, and forests that support healthy watersheds and ecosystems; and
- Programs, Incentives, Outreach, and Education... 21st century approaches to drought preparedness and water security.

Several million dollars in both state and federal assistance is already being utilized by the City of Altus and Mountain Park MCD to implement various SWAP initiatives. This includes funding from:

- Clean Water and Drinking Water State Revolving Fund (SRF) Programs administered by the OWRB and Department of Environmental Quality and supported by capitalization grants from the U.S. EPA and other funding sources;
- Cost-share grants through the Bureau of Reclamation's Drought Response Program, which supports the development of drought contingency/ emergency plans and implementation of projects to increase drought resilience; and
- A grant from the Oklahoma Emergency Drought Relief Commission.

WestFAST and NDRP agencies and the State of Oklahoma collectively offer dozens of additional funding programs, as well as expert technical support, that could potentially assist SWAP partners in maximizing the region's drought resiliency. A detailed examination of these resources will be included in the draft WestFAST/NDRP SWAP plan expected later in 2018.

Water Conservation Tips

(courtesy Oklahoma Water Resources Board/Water for 2060)

- If you step on your lawn and the grass springs back, it does not require water.
- Water early in the morning (4 to 7 a.m.) to reduce evaporation.
- Use a broom rather than a hose to clean driveways, sidewalks, and porches.
- Use native and drought-tolerant plants that require less water.
- Turn off the tap while brushing teeth or shaving.
- Install a low-flow shower head (2.5 gpm or less) and faucet aerators for the sink.
- Install a low-volume flush toilet.
- Do not use the toilet to flush away trash that can be thrown into a wastebasket.
- Plug up the sink or use a wash basin if washing dishes by hand.
- Only run the dishwasher fully loaded.
- Keep a pitcher of drinking water in the refrigerator instead of letting the faucet run until the water is cool.
- Thaw food in the refrigerator overnight rather than using hot water from the tap.

The SWAP Task Force is an active supporter of Oklahoma's Water for 2060 initiative.