



CITY OF BROKEN ARROW WATER CONSERVATION PROGRAM

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CITY OF BROKEN ARROW

WATER CONSERVATION PROGRAM

1.0 INTRODUCTION

1.1 Water Conservation Program

The primary objective of the Water Conservation Program for the City of Broken Arrow (“the City”), through its public trust the Broken Arrow Municipal Authority, collectively known as the City, is to develop a short-term water emergency plan that implements a three-stage water conservation plan. The program is to assure city customers of an adequate water supply to meet their basic needs. The efficient use of water also has the beneficial effect of postponing major water treatment plant expansion, limiting the resultant increase in water rates and conserving the limited resources of the City, as well as the State of Oklahoma. Ultimately, water conservation is a shared responsibility between the City, the Broken Arrow Municipal Authority (“the Authority”) and all water customers of the City of Broken Arrow.

Water conservation measures are those actions taken by the City and/or its customers that ultimately reduce demand for water, improve efficiency in water use and reduce water losses and waste. Hence, water conservation measures are recommended to be used on a continuous basis to promote overall water use efficiency. Temporary, short-term water conservation programs are designed to be used only as long as an emergency exists; whereby, the system demand exceeds the total quantity of water made available to the system whether produced at a treatment facility owned by the city or the Authority or in conjunction with treated water purchased from another system.

1.2 Benefits of a Water Conservation Program

The following aspects are considered as specific benefits associated with this Water Conservation Program:

- (1) Enable the city & the Authority to assure adequate quantities of potable water is available for the customers of City of Broken Arrow in order to meet their domestic needs for health, safety and wellbeing.
- (2) Allow the city & the Authority to maintain an adequate supply of water for essential overall personal, commercial and industrial needs, as well as a sufficient supply for life safety and fire suppression needs.
- (3) Maximize the availability of stored water in the six (6) storage facilities located within the water distribution system.
- (4) Educate customers about more efficient water use during periods of peak demand, typically seen during the months of July, August & September.

2.0 BACKGROUND INFORMATION

2.1 History of the City of Broken Arrow and the Broken Arrow Municipal Authority's Water System

The City of Broken Arrow water treatment plant was constructed in 1966 and became operational in 1967. It drew raw water from the oxbow portion of the Verdigris River as the water source. The plant was located about one quarter mile north of East 71st Street South and South 353rd East Avenue (Lone Star Road) in close proximity to the river. It was a conventional surface water treatment plant that was rated for 4.0 million gallons per day (MGD) and produced all the potable water needs for the city of Broken Arrow. In 1976, the capacity of the water treatment plant was expanded to approximately 10.0 MGD. In the late 1970's, with the recent discovery of disinfection byproducts and the harmful effects thereof, city leaders determined the finished water quality of the City of Broken Arrow water treatment plant could not meet the impending Drinking Water Standards established by the Environmental Protection Agency (EPA).

In 1979, the City proceeded with the design and construction of a 36" transmission pipeline to convey finished water from the Mid-America Industrial Park in Pryor, Oklahoma, to the City of Broken Arrow water treatment plant. The approximately 23-mile long line is commonly referred to as the OOWA (Oklahoma Ordnance Works Authority) transmission line. In the midst of this effort, the City of Broken Arrow established the Broken Arrow Municipal Authority (BAMA) in accordance with state statutes on Public Trusts to oversee the City's utilities. The water line was commissioned and placed in-service on January 1, 1982. The Authority entered into a 31-year contract with OOWA to purchase treated water sufficient to meet the needs of the growing community. The contract was set for expiration on December 31, 2012. In addition, the Authority also built a 2 million gallon (MG) clearwell storage reservoir for intermittent storage and a high service pump station at the water plant to pump the purchased water into the Authority's distribution system. After the OOWA line was placed in-service, the Verdigris River Water Treatment Plant sat idle and was rarely operated, except during emergencies or to supplement the extremely high peak summer water demands.

2.2 Long-Range Water Supply Plan

In 2004, the City of Broken Arrow appointed a "Long-Range Water Supply Committee" to evaluate options for meeting the City's long-range water demands and to develop a plan to meet these needs. The committee evaluated several alternatives for an estimated projected water demand of 50 MGD corresponding to the year 2060.

The alternatives were evaluated with regard to cost, reliability and public acceptability. Ultimately, Alternative No. 1 "Renew OOWA water purchase contract and construct a new water treatment plant on the Verdigris River," was selected by the Committee as the preferred recommendation. In March 2006, the City Council adopted the recommendation of the Long-Range Water Supply Committee and commissioned staff to immediately implement the plan.

2.3 Verdigris Water Treatment Plant

In 2006, a contract with a professional engineering consulting firm was approved to perform raw water quality testing on the Verdigris River as a potential water source, as well as evaluate the Authority's current water rights and the drought of record for both the Verdigris River and Grand River watersheds. In 2008, based on the recommendations of the Long-Range Water Supply Committee, a micro-filtration membrane water treatment

facility adjacent to the original conventional water treatment plant was designed. The current Verdigris Water Treatment Plant is rated for 20 MGD and has been in operation since April 10, 2014.

2.4 Service Area

Broken Arrow is part of the Tulsa metropolitan area that surrounds the city of Tulsa. The city limits currently cover approximately 56 square miles in area. An annexation fenceline extends this area to approximately 101 square miles. This fenceline borders the city limits of the surrounding communities. There are sufficient undeveloped areas within the current city limits combined with the potential area contained by the fenceline for the City of Broken Arrow to more than double its population. However, it should be noted that a significant amount of the community's potential growth resides in Wagoner County. The vast majority of the city that lies in Wagoner County is served by Wagoner County Rural Water District No. 4 or No. 5.

2.5 Population

Broken Arrow is a rapidly growing community. Historical population totals from 1960 to 2010 are shown in Table No. 1. The population for the city of Broken Arrow was relatively flat from before the beginning of statehood until the 1940's.

After World War II, Broken Arrow began to experience a moderate growth increase that is largely attributed to a sense of community, good educational opportunities, public safety, and economic opportunities specifically with coal-mining. The 1960 United States Census placed Broken Arrow's population at 5,928. The next four decades showed tremendous growth with the population increasing to 74,859 by the 2000 census. The current population is estimated to be around 107,794 for 2016.

In 1950, the State of Oklahoma Department of Transportation (ODOT) constructed a highway bypass from just south of Oneta to East 71st Street South (Kenosha Street). This bypass opened up several thousands of acres for residential, industrial and commercial development. Later, in 1965, ODOT once again completed construction on another bypass and opened the Broken Arrow Expressway from Kenosha Street to eventually downtown Tulsa. These crucial events and critical factors along with others greatly impacted the growth of the community. Likewise, this population growth directly affected the Authority's utility systems, specifically in this case, the water supply system.

Population projections indicate that Broken Arrow will double in size over the next 50 years. This projected growth will create the need to significantly increase the water supply system in order to maintain the Authority's high quality of treated water for its customers.

2.6 Water Distribution System

The Broken Arrow Municipal Authority's water distribution system is depicted as Exhibit "A". The key components of the current system include the following elements:

- (1) Water lines ranging from 2" to 48" that total about 600 miles in length.
- (2) Distribution network of pipes holding about 19 MG of treated water.
- (3) Six (6) water storage tanks that are situated at the following locations:
 - 51st Street tank (Battle Creek) -5 MG

- 71st Street has three tanks (Tiger Hill) -4 MG combined
- 101st Street tank (Skaggs tank)-1 MG
- High Elevation tank (First Baptist tank)-1 MG

(4) Total finished water storage within the system is 11 MG:

10 MG in the low pressure plane and 1 MG in the high pressure plane

2.7 Supplemental Water Connections

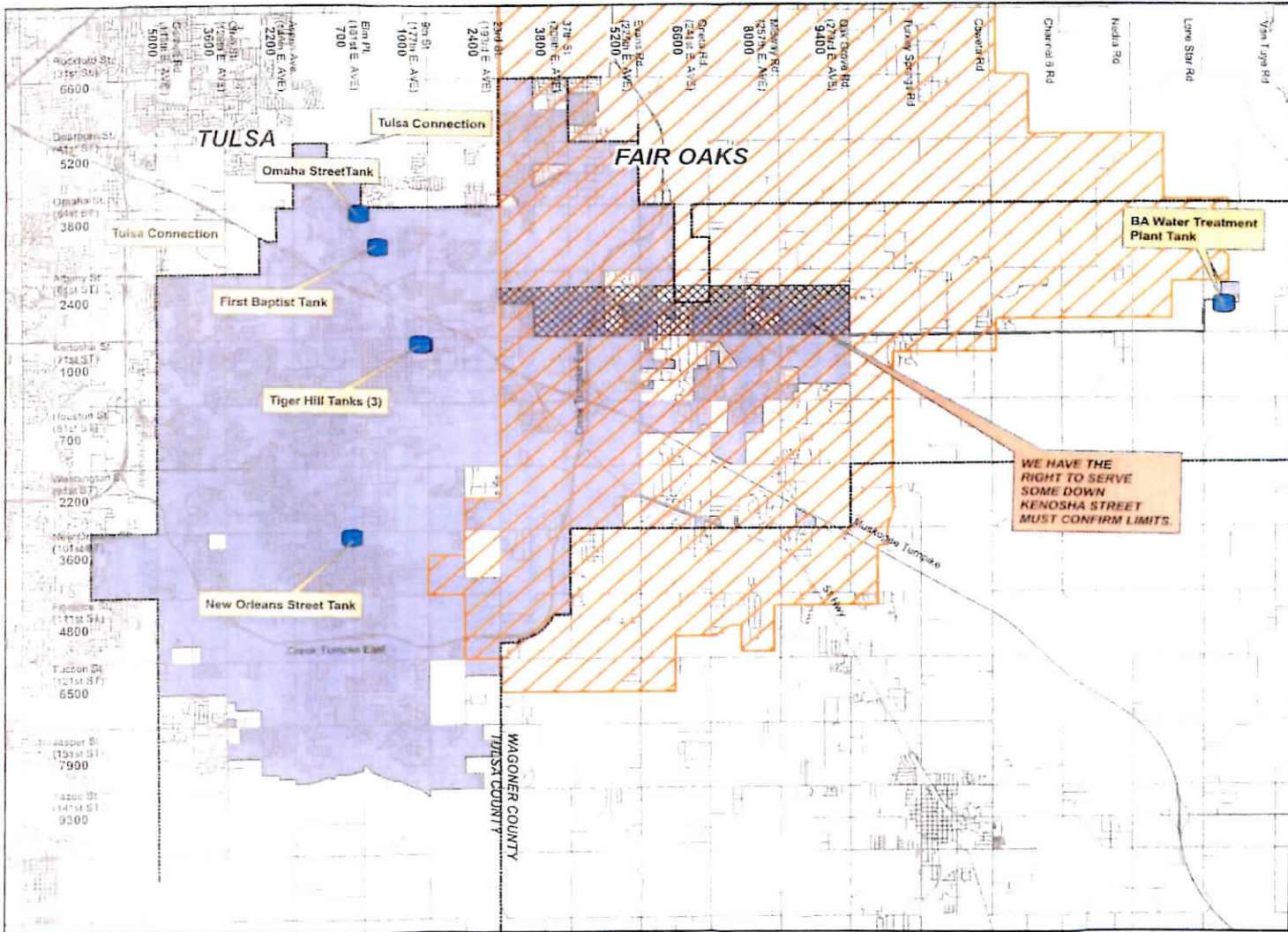
The Broken Arrow Municipal Authority has contracted with the Tulsa Metropolitan Utility Authority (TMUA) to purchase finished water from two (2) master-metered water connections. These connections are in-place in order to draw additional water to supplement the seasonal increased demand, usually experienced during the months of July through September, on an annual basis, as well as during infrequent major plant operational shut-downs or system-wide emergencies. The Authority is positioned to take about 4.5 MGD. The two connections include:

- (1) 24" pipe along Elm Place at Dearborn Street (41st Street) and
- (2) 6" pipe along Garnett Road and Albany Street (61st Street)

Presently, the Authority is working in concert with TMUA to incorporate a third master-metered water connection at Olive Avenue (129th East Avenue) and Albany Street (61st Street South). This connection is a 24" pipe and supplies an additional 5 MGD.

Collectively, the supplemental water connections can provide the system an additional 9 MGD plus treated water while the Authority's plant supplies about 19 MGD.

EXHIBIT "A"
 WATER DISTRIBUTION NETWORK



Legend

Structure Type

- Water Tanks Storage
- BA Fenceline
- BA Service Area
- Rural 4 Water Boundary

BA CITY LIMITS

- BA CITY LIMITS



BAGIS 2016

CITY OF BROKEN ARROW
 PWSID #OK1021508
 2016



Scale: N.T.S

3.0 WATER DEMAND

3.1 Historic Water Demand Analysis

The City of Broken Arrow's total daily, monthly, and annual water demand fluctuates for any given period and is subject to several external factors, which include the following:

- (1) weather conditions (wet year vs dry year),
- (2) community's population growth, and
- (3) cost of water to customers.

In order to more accurately predict future water demands that may be experienced and applied to the overall system, staff conducted an extensive and comprehensive analysis of the historic demands experienced by the water supply system. Staff gathered and collected historic daily records dating back to 1998, and extending through 2015. A review of this data (Table 2) leads to several conclusions. First and foremost, it indicates that the years 2000, 2011 and 2012 produced the some of the worst conditions encountered by the water system that resulted in the greatest demands experienced by the system due to maximum use by the customers. Second, the data reflects how the system responds during periods of drought like 2006 and periods cooler, wet weather like 2004 and 2009.

Over the past 18 years, the water system has experienced peak daily demands of 26.0 MGD or more ten (10) occasions. The historical maximum peak daily demand is 26.9 MGD, which occurred on August 3, 2012. Likewise, it should also be noted that the system has experienced peak monthly demands of 600 MG of water or more four (4) times. These peak monthly demands are: (1) August 2000 with 619.9 MG; (2) July 2011 with 690.1 MG; (3) July 2012 with 722.2 MG; and (4) August 2012 with 609.9 MG. The historic peak month, July 2012 with 722.2 MG, equates to an average daily demand of 23.3 MGD.

In addition, records indicate eight (8) of the last 18 years the system experienced four (4) billion gallons (BG) of water demand or more over those specific years. In fact, twice the system delivered four and a half (4.5) BG of water or more. In 2006, the water system delivered 4,585,200 gallons throughout the course of the year. This is compared to 4,643,400 gallons of water used in 2012, the highest year on record. These two (2) years equate to an average monthly demand of 382.1 MG and 386.9 MG, respectively.

Another water usage factor of interest is the maximum three (3)-month peak demand value. Records indicate the only one time in history has the water system delivered over 1.8 MG over a three consecutive month period. In 2012, the total amount of water delivered by the water supply system to the customers from June through August equated to 1,825,100 gallons. Essentially, the system on average delivered nearly 608.4 MG per month for an entire summer. In essence this three (3) month demand equates to an average daily demand of 19.8 MGD for 92 consecutive days.

Furthermore, two (2) other crucial factors to investigate and examine include the peak 3-day demand and the peak 7-day demand. Both of these factors occurred during the same period, the last week of July 2012 and the first week of August 2012. The system averaged just over 25.9 MGD for a seven (7) consecutive day period beginning July 29, 2012 through August 4, 2012. In addition, the system averaged almost 26.3 MGD for three (3) consecutive days between July 29, 2012 through August 1, 2012.

The historical peak demand and the projected future water demand data is essential to assist the Authority as a decision-making tool to set appropriate limitations as a part of the Water Conservation Program.

3.2 Water Demand Projection

In estimating the water demand projections for up to the year 2060, the estimated increases in annual water demand has been projected at a rate of approximately 2.2% per year based on historical trends. The peak day water demand is based by using a peaking factor of 2.1 times the average daily demand. The highest monthly water usage over a three-month period occurs in July, August and September of each year. The amount of water used during these three-month average water use and this value was found to be 1.52 times the average monthly water use.

3.3 System Loss

(A) Water Treatment Plant

Raw water is delivered to the Verdigris River Water Treatment Plant 260 MG pre-sedimentation basins utilizing three (3) 10.0 MGD raw water pumps. Water leakage in the approximately 3/4 mile 42" transmission line is monitored. Losses within the boundaries of the treatment plant are minimal. Losses are attributed to evaporation of the water stored in the two (2) pre-sedimentation basins, the backwashing of Pall microfiltration system and the desludging of the accumulated sludge in the four (4) Pretreatment Basins.

(B) Distribution System

Utilities Department field personnel actively pursue and repair all reported water leaks and main line breaks to minimize system loss. The unaccounted for water in the Authority's water distribution system is estimated to be about 5-7%. Line maintenance standby crews are available 24 hours a day to address system failures as they occur. Upon being contacted of a line failure or any reported leak, the crews respond quickly and take appropriate corrective action to repair the leak.

(C) Water Customer Profile

Although the city of Broken Arrow is the third leading manufacturing community in the state of Oklahoma, the land use is not heavily industrialized. Instead, residential customers consume the majority of water produced. Within Broken Arrow there are about 1,935 large water consumers out of a total of about 36,065 metered customers.

3.4 Conclusions

Water demand is influenced by the population served, per capita water use, weather conditions and water rates. The water supply capability is largely a matter of available water from both the Broken Arrow Municipal Authority's Verdigris River Water Treatment Plant and the Tulsa Metropolitan Utility Authority's water connections. To assess Broken Arrow's ability to meet future needs, a long-term water supply plan was developed to address water system improvements and plant expansion needs based on projected trends in water usage. These efforts were based on historical data collected from Broken Arrow's operational records as well as historical growth trends.

4.0 WATER CONSERVATION MEASURES

4.1 Introduction

The City of Broken Arrow addresses water shortage issues and preventive proactive measures in accordance with this Water Conservation Program. The water shortage may be the result of a drought, unusual demand, or a system failure. A drought may deplete the available water supply or place stress on the Authority's ability to deliver water and unanticipated demands could exceed the supply system's capacity. A system failure could occur that may reduce the ability to deliver water to the entire service area.

The Water Conservation Plan applies to all persons, customers and properties served by the Authority. All entities that purchase water from the Authority will be required to follow the same reductions in water use as the City of Broken Arrow.

Outdoor irrigation is a component of water use that looks promising when looking for ways to reduce water usage. Summer peak days' usage are approximately double the daily average usage. For calendar year 2015, the customers used an average of 10.71 MGD and experienced a peak day usage of about 20 MGD per day.

Customers are encouraged to irrigate in the morning between midnight and 6:00 am when it is cooler, therefore less evaporation occurs. On hot and windy days, the amount of water that evaporates before it reaches the grass can be substantial. Customers, both residential and commercial, are requested to maintain and review irrigation sprinkler operations, to repair broken sprinkler heads and prevent watering of sidewalks and streets.

During periods of water conservation, the City's Water Conservation Program enables the City Manager to implement conservation stages when certain conditions and criteria are met. With the implementation of each conservation stage, the City Manager may sign a proclamation and publish a notice of the implementation of the specific conservation stage and associated information in the local newspaper, social media, the city web page and utilize the city-wide call back system ("robo call/reverse 911"). City police officers shall enforce the limits set by each conservation stage should efforts to educate the public be ineffective to ensure adequate water supplies are maintained for its customers.

Other known sources of water loss include:

- (1) Periodic flushing of fire hydrants at dead ends to maintain water quality in the distribution system.
- (2) Automatic flushers installed at dead ends of long stretches of water main lines with few service connections to flush periodically and maintain the water quality in the main lines. All quantities of water flushed is recorded and totaled by the Water Quality Technician. Efforts are also underway to eliminate dead ends by looping the water lines.
- (3) Replacement of old, fatigued and high mileage water meters that reportedly under register water consumption. Phase I of the Automated Meter Reading project that is targeting to replace about 9,000 water meters and convert existing new meters to a drive by radio read meters over a two-year period was recently implemented. The goal is to change out and convert all 36,000 meters over a six- year period.

Please note that hand watering landscape and gardens with a hand held hose with a shut off valve is allowed any time. Soaker hoses are also allowed any time throughout all stages listed within this program.

4.2 STAGE ONE-Voluntary Water Conservation

All customers of the City of Broken Arrow will be in Stage 1 voluntary water conservation to reduce peak water usage.

Conditions indicate that the probability of a water shortage is rising and steps should be taken to inform customers and ask for voluntary reductions in water use. No serious threat to water supplies is imminent, but the Utilities Department shall be watching closely the water supply situation.

Goals:

The goals of this stage one are:

- To heighten public awareness of water supply and system demand conditions.
- To ask for voluntary reduction in outdoor water use to avoid having to implement mandatory restrictions.
- To maintain the integrity of the water supply system and to endure essential water needs, including life safety and fire suppression.

Education Actions:

1. The City will provide educational information to water customers about ways to conserve water using the following outlets: news releases on local newspaper, TV, radio stations, city wide call back system ("robo call/reverse 911"), social media and the City's website. All information shall be issued through the Public Information Officer.
2. The City will make weekly news releases to the local media describing present conditions and indicating the water supply outlook for the upcoming week, asking customers for voluntary water conservation measures.
3. The City will post "Water Watch" information on the City website and utilize the website to provide updates.

Management Actions:

1. System pressure will be maintained within normal operating pressure ranges.
2. The Utilities Department will monitor use of water and will reduce activities such as hydrant flushing and street cleaning. Fire Department will be advised to refrain from hydrant testing, etc.
3. The City will suspend or reduce outdoor watering of landscaping on medians and at City facilities to conserve water. Restriction of water use at the city facilities shall require:
 - i. All spray pools (splash pads) to be turned off.
 - ii. Nighttime watering only (from sundown to sunup) is permitted at golf courses, sport fields, the Rose District and other sensitive plant locations.
4. System water demand will be satisfied by the capacity of treatment plant and Tulsa Metropolitan Utility Authority (TMUA) connections.

Regulation Actions:

The City shall promote water conservation during the summer months, when outdoor water use for lawn and landscape watering accounts for as much as 70 percent of the water delivered to households. When conditions require a reduction in water demands to avoid implementing mandatory restrictions, customers will be urged to reduce outdoor water use. When it is first recognized that a water supply problem is developing, the following voluntary water conservation measures will be requested.

- (a) Implement an alternate day (odd/even) schedule for outdoor watering.
 - last number of the building address-1,3,5,7, & 9 water on odd number calendar days
 - last number of the building address-0,2,4,6,8 water on even number calendar days
- (b) Limit nonessential outdoor water use and reduction in outdoor watering.
- (c) Water between 6 P.M. and 6 A.M. only
- (d) Reduce outdoor water use on weekends.
- (e) Use a soaker hose to apply water efficiently to plants.
- (f) Limit car washing at home or use a commercial carwash that recycles water.
- (g) Avoid hosing down outside areas such as sidewalks, patios and driveways.

Requirements for Termination of Stage 1 Voluntary Water Conservation:

The Stage 1 Voluntary Water Conservation will be terminated when the triggering events have ceased to exist, but the City will continue to promote wise outdoor watering throughout the summer months.

When conditions are such that more stringent conservation measures are required, a Stage 2 shall be declared and mandatory conservation measures will be required.

4.3 STAGE TWO-Moderate Water Conservation

As the water supply problems become more severe, a Stage 2 Water Conservation will be implemented. In a Stage 2 Water Conservation, water shortage conditions are present and or water supplies are declining. Additional reductions in water use are requested, and mandatory restrictions are placed on outdoor water use. The City is able to meet demands as they exist, but lowering the demands will extend the City's ability to meet future demands without significant disruption. The following requirements will be in effect throughout a Stage 2 Water Conservation.

Triggers:

A Stage 2 Moderate Water Conservation is in effect when any one of the following conditions occurs.

- 1. Daily water demand for 3 consecutive days is in excess of 95% of the treatment capacity of the water treatment plant and TMUA connections.
- 2. Total system storage does not recover above 70% prior to 5 A.M.

Goals:

The goals of this stage are:

- To reduce peak demands to manageable levels.

- To maintain the integrity of the water supply system to ensure essential water needs, including life safety and fire suppression.

Education Actions:

1. The City will make news releases to the local media describing present conditions and the water supply outlook and description of the water restrictions in effect.
2. The City Manager will make public announcements through the news media concerning the Stage 2 Water Conservation and the water use restrictions in effect. The announcement will include a description of the restrictions.
3. The City will post information on the City's website, social media, TV, radio stations and through the city wide call back system ("robo call/reverse 911").

Management Actions:

1. Review previous week summaries of precipitation, temperature, water storage tank levels.
2. The City will suspend outdoor watering with potable water, including operation of fountains, watering of City grounds and washing of vehicles. Restriction of water use at city facilities shall include:
 - i. Shutting down of all spray pools (splash pads), all fountains, Veteran's Park and interactive water feature.
 - ii. Night time watering only (from sundown to sunup) is permitted for greens at golf courses, the Rose District and other sensitive plant sites.
3. System water demand will be satisfied by the treatment capacity of the water treatment plant and TMUA connections.
4. Eliminate non-essential city water use (eg. street cleaning, flushing of water lines, fire hydrant testing, etc).
5. Washing or hosing down of buildings, sidewalks, driveways, parking areas or any paved surface is prohibited.

Regulation Actions:

1. A mandatory odd/even lawn watering schedule (or equivalent demand reduction procedures) will be imposed on all water customers. Customers with odd-numbered addresses will water on odd-numbered calendar days and even-numbered addresses will water on even-numbered calendar days. These restrictions shall not apply to any person, firm or corporation engaged in the business of growing or selling plants of any kind. Additional exceptions may be granted on a case by case basis.
2. Outdoor water use, including lawn watering and car washing, will be restricted to after 6:00 P.M. and before 6:00 A.M.
3. Golf courses and sports fields will be restricted from watering with potable water.

Requirements for Termination of Stage 2 Moderate Water Conservation:

The Stage 2 Moderate Water Conservation shall terminate when the triggering events have ceased to exist for a period of fourteen (14) consecutive days or when substantial changes in weather conditions occur, affecting water demands. Upon termination of Stage 2 Moderate Water Conservation, and if conditions begin to

deteriorate, a Stage 3 Emergency Water Conservation becomes operative. When prevailing conditions are such that more stringent conservation measures are required, a Stage 3 Emergency Water Conservation shall be declared and mandatory conservation measures will be required.

4.4 STAGE THREE-Emergency Water Conservation

As the water supply problem continues to deteriorate, a Stage 3 Emergency Water Conservation will be implemented. In Stage 3 Emergency Water Conservation, severe water shortage conditions are present and supplies are limited. Mandatory restrictions on outdoor water use are in place. System failure is a possibility and if conditions do not improve or demands do not decline. The following restrictions will be in effect during a Stage 3 Emergency Water Conservation:

Trigger:

A Stage 3 Water Conservation is in effect when any combination of one or more of the following conditions occur:

1. Areas of the water distribution system have reduced water pressure less than 25 psi for 24 hours or more.
2. Daily water demand for two (2) days is in excess of 100% of the treatment capacity of the treatment plant and City of Tulsa connections.
3. Total system storage does not recover above 60% prior to 5 A.M.
4. There is a reduction in the long term supply of water (i.e. supply shortage, pumps down, breaks in the transmission line, contamination of raw water supply, etc.).

Goals:

The goals of this stage are:

- To reduce peak demands to manageable levels.
- To maintain the integrity of the Authority's water supply system to ensure essential water needs, including life safety and fire suppression.

Education Actions:

1. The City will make daily news releases to the local media describing present conditions and the water supply outlook and a description of the water restrictions in effect.
2. The City Manager will make public announcements through news media that Stage 3 Emergency Water Conservation water use restrictions are in effect. The announcements will include a description of the water restrictions in effect.
3. The City will broadcast "Water Emergency" information on the City's website, social media, TV, radio and city wide call back system ("robo call/reverse 911").
4. The City may hold a public meeting to discuss the emergency, the status of the City's water supply and further actions that need to be taken.

Management Actions:

1. Review previous day summaries of precipitation, highest temperature recorded, water supplied and storage tank levels.
2. The City will suspend outdoor watering with potable water, including operation of fountains, watering of city grounds and washing of vehicles. Restriction of water use at city facilities shall include:
 - i. Shutting down all swimming pools, all spray pools, all fountains, Veteran's Park and interactive water features.
 - ii. Hand watering only is permitted for greens only at golf courses, the Rose District and other sensitive plant sites.
3. System water demand will be satisfied by the treatment capacity of the water treatment plant and TMUA connections.
4. Eliminate all non-essential city water use.
5. Washing or hosing down of buildings, sidewalks, driveways, parking areas or any paved surface is prohibited.

Regulation Actions:

As the water supply problem continues to deteriorate, additional mandatory restrictions will be placed on essential uses. Stage 3 Emergency Water Conservation restrictions will be in effect whenever additional restrictions are necessary so that no water customers inside the city limits will be without water. The following restrictions will be in effect during a Stage 3 Emergency Water Conservation.

- (a) Outdoor water use with potable water will be totally prohibited. This includes but is not limited to the following: water used for outdoor watering, either public or private, for gardens, lawns, trees, shrubs, plants, parks, golf courses, playing fields, swimming pools or other recreational areas; or the washing of motor vehicles, boats, trailers or the exterior of any building or structure.
- (b) Only non-potable water sources may be used to perform the outdoor watering.
- (c) Golf course watering and irrigation using potable water shall be limited to greens only.
- (d) Use of potable water at construction sites for dust control, compaction of wash down is prohibited.

Requirement for Termination of Stage 3 Emergency Water Conservation

The Stage 3 Emergency Water Conservation shall be terminated when the triggering events have ceased to exist for a period of fourteen (14) consecutive days. Upon termination of a Stage 3 Emergency Water Conservation, a Stage 2 Moderate Water Conservation becomes operative.

5.0 OUTREACH, OPERATIONS AND ENFORCEMENT

5.1 Public Outreach

Every May, the Water Utilities staff shall work closely with the Public Information Officer to reach out to all City water customers and citizens of Broken Arrow to remind them through the Focus newsletter that a Water Conservation Program is in place. The Water Conservation Program shall be implemented (if conditions warrant the initiation of the plan) to protect the health, safety and wellbeing of the citizens. As responsible citizens, their assistance and cooperation is needed to make the conservation plan work and be successful.

5.2 Operations Plan

The Water Treatment Plant Manager and plant staff are responsible for monitoring the plant water production output, rate of water extraction from TMUA connections and the six offsite storage tank levels. The needed information is available from the plant SCADA system and the telemetry communication with the tanks.

In the event of an emergency situation brought about by sudden increase in water demand due to rising day time temperatures or any other water production or delivery issues as elaborated in the Water Conservation Program, a line of communication has been established and shall be adhered to. Clear, good communication and timely dissemination of information is critical and being proactive is vital for the overall success of the program.

The established chain of communication is as follows:

- (i) Plant staff shall provide the Director of Utilities an update every three hours pertaining to the water production rate, the six tank levels and the rate of water draw from TMUA connections.
- (ii) Director will review the information provided and forward it to the Assistant City Manager-Operations with the Director's comments on any action that needs to be taken. Assistant City Manager could direct staff to contact PD dispatch to do a "robo call" to advise the residents of the water supply situation and request appropriate follow up action.
- (iii) The Assistant City Manager will review and advise/discuss with the City Manager on the overall situation with respect to system demand versus water availability. City Manager could issue a press release to provide the citizens an update on the water situation and request appropriate follow-up action.

5.3 Enforcement

As the City Manager signs a directive and a notice of the implementation of the specific stage of conservation program being initiated, city police officers shall enforce the limits set by each conservation stage. The enforcement action is necessary to ensure the Authority maintains adequate water supplies for its customer's safety, health and wellbeing.

TABLE 1-POPULATION GROWTH

YEAR	1960	1970	1980	1990	2000	2010	2016
POPULATION	5,928	11,787	35,761	58,043	74,859	98,850	107,794

TABLE 2 - HISTORICAL WATER DEMAND ANALYSIS FROM YEARS 1998 THROUGH 2015

YEAR	MONTHLY DEMAND													ANNUAL AVG DAY	ANNUAL MAX DAY	PEAKING FACTOR
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1998	235.7	213.1	236.5	265.9	332.9	403.7	470.2	519.9	462.5	284.1	244.0	245.0	3,913.5	10.7	24.3	2.3
1999	248.4	215.3	243.1	254.8	285.1	283.1	516.0	660.9	348.3	328.3	273.2	255.0	3,911.5	10.7	25.7	2.4
2000	255.8	233.6	245.3	280.1	314.3	298.3	426.5	619.9	547.5	339.2	248.4	254.5	4,063.4	11.1	26.1	2.3
2001	256.6	223.4	244.5	292.8	346.2	405.9	581.6	597.2	402.0	343.6	281.6	260.9	4,236.3	11.6	25.7	2.2
2002	264.6	233.7	260.0	277.1	310.6	396.2	514.7	508.1	455.1	355.6	263.6	258.6	4,097.9	11.2	24.5	2.2
2003	257.6	229.5	258.4	295.2	354.2	368.7	569.4	517.4	326.1	302.9	263.5	257.0	3,999.9	11.0	23.2	2.1
2004	249.8	238.7	258.2	279.0	377.2	355.0	398.2	419.0	459.4	324.2	267.7	263.2	3,889.6	10.6	18.6	1.8
2005	261.7	227.1	267.2	297.3	382.4	465.5	597.4	498.4	418.1	372.8	319.1	289.6	4,396.6	12.0	25.3	2.1
2006	322.3	267.6	308.8	376.2	389.8	459.2	582.2	590.4	380.7	351.6	286.4	270.0	4,585.2	12.6	25.3	2.0
2007	269.4	240.0	276.6	284.7	322.2	316.8	365.1	529.3	333.6	307.7	283.2	256.4	3,785.0	10.4	22.8	2.2
2008	254.3	231.8	253.8	260.5	326.2	313.2	434.8	453.8	337.2	325.1	265.9	257.7	3,714.3	10.1	22.2	2.2
2009	253.0	228.8	269.3	262.3	300.8	458.1	521.5	446.2	295.2	272.5	250.3	243.0	3,801.0	10.4	22.0	2.1
2010	262.6	220.6	245.1	270.9	329.9	395.4	427.0	580.4	368.0	346.3	277.3	248.9	3,972.4	10.9	22.5	2.1
2011	250.4	239.4	254.1	303.1	328.2	465.9	690.1	555.3	428.9	352.1	270.4	247.4	4,385.3	12.0	26.1	2.2
2012	253.9	233.1	261.4	299.3	441.8	493.0	722.2	609.9	420.3	341.4	301.4	265.7	4,643.4	12.7	26.9	2.1
2013	252.5	218.7	248.8	249.5	294.9	386.8	534.3	459.2	491.4	313.9	254.5	273.8	3,978.3	10.9	23.8	2.2
2014	278.9	252.3	281.0	304.5	423.9	380.6	490.4	460.0	400.5	325.6	266.0	258.8	4,122.5	11.3	19.4	1.7
2015	273.5	234.9	265.2	274.2	287.8	399.1	422.9	402.0	417.9	397.8	278.4	263.9	3,917.6	10.7	19.5	1.8
MIN	235.7	213.1	236.5	249.5	285.1	283.1	365.1	402.0	295.2	272.5	244.0	243.0	3,714.3	10.1	18.6	1.7
AVG	261.2	232.3	259.9	284.9	341.6	391.4	514.7	523.7	405.2	332.5	271.9	259.4	4,078.5	11.2	23.6	2.1
MAX	322.3	267.6	308.8	376.2	441.8	493.0	722.2	660.9	547.5	397.8	319.1	289.6	4,643.4	12.7	26.9	2.4
% VAR. ABOVE	23.4%	15.2%	18.8%	32.1%	29.3%	26.0%	40.3%	26.2%	35.1%	19.6%	17.3%	11.6%	13.8%	13.6%	14.2%	13.7%
% VAR. BELOW	9.8%	8.3%	9.0%	12.4%	16.5%	27.7%	29.1%	23.2%	27.1%	18.0%	10.3%	6.3%	8.9%	9.1%	21.0%	18.6%
% TOT VAR.	33.2%	23.5%	27.8%	44.5%	45.9%	53.6%	69.4%	49.4%	62.3%	37.7%	27.6%	18.0%	22.8%	22.7%	35.2%	32.3%

TABLE 3 - HISTORICAL PEAK MONTHLY

Monthly Demand over 600 MG	
Peak Month	Usage
August 1999	660.9
August 2000	619.9
July 2011	690.1
July 2012	722.2
August 2012	609.9

TABLE 4 - HISTORICAL PEAK DAILY

Daily Peak over 26.0 MGD	
Peak Day	Demand
August 25, 2000	26.0
September 2, 2000	26.1
August 2, 2011	26.1
August 3, 2011	26.0
July 29, 2012	26.5
July 30, 2012	26.4
July 31, 2012	26.2
August 1, 2012	26.2
August 3, 2012	26.9
August 4, 2012	26.3

TABLE 5-WATER DEMAND PROJECTIONS

Estimated Water Demand	2010	2020	2030	2040	2050	2060
Average Monthly Demand (MG)	376	458	560	620	684	754
Peak Three Month (July-Sept) Average Monthly Demand (MG)	572	698	853	944	1042	1149
Average Day Demand (MGD)	12.5	15.3	18.7	20.6	22.8	25.1
Peak Three Month Average Day Demand (MGD) (1.52 x average day)	19.1	23.3	28.4	31.4	34.7	38.3
Peak Day Demand (MGD) (2.1 x average day)	26.3	32.1	39.2	43.3	47.8	52.8

Note:

- Estimated increases in annual water demands are at a rate of approximately 2.2% per year based on historical trends.
- Peak day water demands were estimated by using a peaking factor of 2.1 times the average daily demand.
- The highest monthly water usage over a three-month period occurs in July, August and September.
- The amount of water used during these three months was averaged to determine the peak three-month average water use, which was found to be 1.52 times the average monthly water use.

APPENDIX A

IMPLEMENTATION SUMMARY			
DESCRIPTIONS	STAGE I VOLUNTARY	STAGE II MODERATE	STAGE III EMERGENCY
TRIGGERS	Probability of a water shortage is rising Steps should be taken to inform customers Ask for voluntary reduction in water use	Daily water demand for 3 consecutive days is in excess of 95% of water availability and/or Total system storage does not recover above 70% prior to 5:00 am	Water pressure is less than 25 psi for 24 hours in the distribution system and/or Daily water demand for 2 days is in excess of 100% of water availability and/or Total system storage does not recover above 60% prior to 5:00 am and/or Reduction in supply of water due to production transmission and delivery problems
GOALS	Heighten public awareness of water supply and demand conditions Request voluntary reduction in outdoor use Maintain the Authority's ability to meet essential water needs including safety and fire suppression	Reduce peak demands to manageable levels Maintain the Authority's ability to meet essential water needs including safety and fire suppression	Reduce peak demands to manageable levels Maintain the Authority's ability to meet essential water needs including water needs for safety and fire suppression
MANAGEMENT ACTIONS	System pressure will be maintained Utility Dept. and Fire Dept. will cease fire hydrant flushing and testing City will suspend/reduce outdoor watering. Spray pools turned off. Night time watering only at golf courses, sport fields, Rose District and at sensitive plant locations. Water demand will be met by WTP and TMUA connections	Review previous week summaries of precipitation, temperature and storage tank levels City will suspend outdoor watering, watering of grounds and shut down fountains, splash pads and interactive water feature. Night time watering allowed for greens at golf courses, Rose District and sensitive plant locations Eliminate all non-essential city water use Water demand will be met by WTP and TMUA connections	Review previous day summaries of precipitation, temperature recorded, water supplied and storage tank levels City will suspend outdoor watering, watering of city grounds and shut down fountains, splash pads and interactive water feature Hand watering only is permitted for greens only at golf courses, the Rose District and sensitive plant locations Eliminate all non-essential city water use Water demand will be met by WTP and TMUA connections
PUBLIC OUTREACH EFFORTS	Public Information Officer to provide educational information to citizens using media outlets, press release and reverse 911 on ways to conserve water	PIO to provide news releases to media describing present conditions, water supply outlook and restrictions in effect City Manager makes public announcements	PIO to provide daily news updates on the current conditions, the water supply outlook and restrictions in effect City Manager will make public announcements about Stage III water conservation restrictions in place

	City will make weekly news releases to the media asking customers to conserve water City to post "Water Watch" on the city website to provide updates	concerning Stage II water conservation and restrictions in place City will update information on city website, through the media and 911 call system	City will broadcast water emergency information through the media City may hold an emergency public meeting to discuss the emergency situation regarding the City's water supply and follow-up actions needed
REGULATORY EFFORTS	Voluntary water conservation measures requested: Alternate day(odd/even) schedule for outdoor watering Last number of building addresses 1,3,5,7 & 9 water on odd calendar days Last number of building addresses 0,2,4,6 & 8 water on even calendar days Outdoor water use between 6pm and 6am Reduce outdoor water use on weekends Use soaker hoses and hand held hose with a shutoff valve Limit nonessential outdoor water use	Mandatory water conservation measures imposed: Alternate day(odd/even) schedule for outdoor watering is implemented Last number of building addresses 1,3,5,7 & 9 water on odd calendar days Last number of building addresses 0,2,4,6 & 8 water on even calendar days Outdoor water use between 6pm and 6am only Golf courses and sports fields are restricted to night time watering of greens only	Emergency water conservation measures imposed: Outdoor water use with potable water is totally prohibited Golf courses watering is restricted to night time watering of greens only
ENFORCEMENT EFFORTS	NONE	City Police Officers shall enforce the limits set in this moderate water conservation stage	City Police Officers shall enforce the limits set in this emergency water conservation stage