

Texas Water Development Board



2016 Region M Water Plan

Chapter 7: Drought Preparations and Response

Table of Contents

List of Abbreviations	ii
Chapter 7. Drought Preparations and Response	7-1
7.1 Introduction.....	7-1
7.2 Drought of Record in Region M	7-1
7.3 Current Drought Preparations and Response.....	7-3
7.3.1 Region M Drought Contingency Plans	7-5
7.3.2 Existing and Potential Emergency Interconnects	7-14
7.4 Emergency Responses to Local Drought or Loss of Municipal Supply.....	7-16
7.5 Region-Specific Drought Response Recommendations	7-19
7.5.1 Amistad-Falcon Reservoir System Drought Response Recommendations	7-19
7.5.2 Groundwater Supply Drought Response Recommendations.....	7-21
7.6 Drought Management WMS.....	7-21

Figures

Figure 7-1 Average Annual Precipitation.....	7-2
--	-----

Tables

Table 7-1 Submitted Water Conservation and Drought Contingency Plans.....	7-3
Table 7-2 Summary of Irrigation District Drought Triggers and Responses	7-5
Table 7-3 East Rio Hondo Water Supply Corporation Drought Response.....	7-8
Table 7-4 Brownsville Public Utilities Board Drought Response	7-9
Table 7-5 City of Laredo Drought Response	7-10
Table 7-6 McAllen Public Utility Drought Response	7-11
Table 7-7 North Cameron Regional Water Supply Corporation Drought Response	7-12
Table 7-8 Southmost Regional Water Authority Drought Response	7-12
Table 7-9 City of Weslaco Drought Response.....	7-13
Table 7-10 Emergency Interconnections between Public Water Supply Systems.....	7-14
Table 7-11 WUGs Identified for Emergency Drought Response Evaluation	7-16
Table 7-12 Emergency Water Shortage Responses: Surface Water Dependent WUGs.....	7-18
Table 7-13 Emergency Water Shortage Responses: Groundwater Dependent WUGs.....	7-19
Table 7-14 Municipal Shortage Scenarios and Recommendations.....	7-19

List of Abbreviations

Acre-ft.	Acre-feet
Acre-ft./year	Acre-feet per year
DCP	Drought Contingency Plan
DMI	Domestic, Municipal and Industrial
DOR	Drought of Record
ERHWSC	East Rio Hondo Water Supply Corporation
IBWC	International Boundary Water Commission
NCRWP	North Cameron Regional Water Plant
No.	Number
PUB	Public Utilities Board
RWPG	Regional Water Planning Group
SRWA	Southmost Regional Water Supply Corporation
WAM	Water Availability Model
WMS	Water Management Strategy
WTP	Water Treatment Plant
WUG	Water User Group
WWP	Wholesale Water Provider

Chapter 7. Drought Preparations and Response

7.1 Introduction

Severe drought has affected Region M in the period that constitutes the current drought of record for the Rio Grande basin (1993-2000), and more recently in 2011-2013. Because of the unique mechanism for fulfillment of water rights of the Rio Grande system, and the heavy reliance on that source, drought impacts Region M somewhat differently than other regions. Also, a significant portion of the water used in Region M does not fall as rain on the region, but comes from the Mexican side of the Rio Grande Watershed.

Drought and other circumstances can contribute to a water shortage, which is any situation when there is less supply of water than there is demand for water. Shortages can be the result of low rainfall, operational decisions, higher than normal temperatures or growing populations causing increased demand. Drought preparation and response can help to mitigate the impacts of these shortages by finding ways to reduce demands and supplement supplies in response to water shortages.

The Texas Department of Public Safety submitted recommendations from the Drought Preparedness Council to all of the Regional Water Planning Groups (RWPG) on November 10, 2014. The Council advised the RWPG to follow the TWDB template for this chapter and to examine the impact of unanticipated population or industrial growth on the ability of the Region to prepare for drought. These recommendations have been considered in the development of this chapter.

This chapter is intended to consolidate what existing information there is on current drought preparation and response activities for Region M, and make recommendations where needed.

7.2 Drought of Record in Region M

The Drought of Record (DOR) is the basis of the Firm Yield projection for each surface water supply. The DOR identifies the worst drought on record and the Firm Yield is the supply that can be expected from that river or system in that most severe drought scenario.

The Rio Grande Basin and the Amistad-Falcon Reservoir System refer to the drought spanning from February 1993 to October of 2000 as the DOR. This 7.75 year period is the most severe hydrologic drought according to the Rio Grande Water Availability Model (WAM), and is used to predict firm yield over the planning horizon, as discussed in Chapter 3. The WAM takes into account reduced inflows from both Mexican and U.S. tributaries associated with the drought of record, volumes and locations of demands along the river, channel losses along the river, and other factors. The deliveries from Mexico are not modeled according to the 1944 Treaty, which establishes 350,000 acre-ft./year to be delivered to the US, but are modeled instead according to historical supplies and demands. Firm Yield decreases slightly each decade from reduced reservoir capacity due to sedimentation.

The naturalized flow data in the WAM only extends through the year 2000, which may have an impact on the DOR. The actual drought extended through approximately 2003, and if the WAM were updated to include those years, the severity of the DOR and therefore the firm yield of the Amistad-Falcon Reservoir system may be affected. Recent years have also seen severe drought in the region, and 2011 and 2012 data could similarly impact the drought of record. It was

recommended in the 2011 Regional Water Plan, and is the opinion of the current RWPG, that the Rio Grande WAM should be updated regularly.

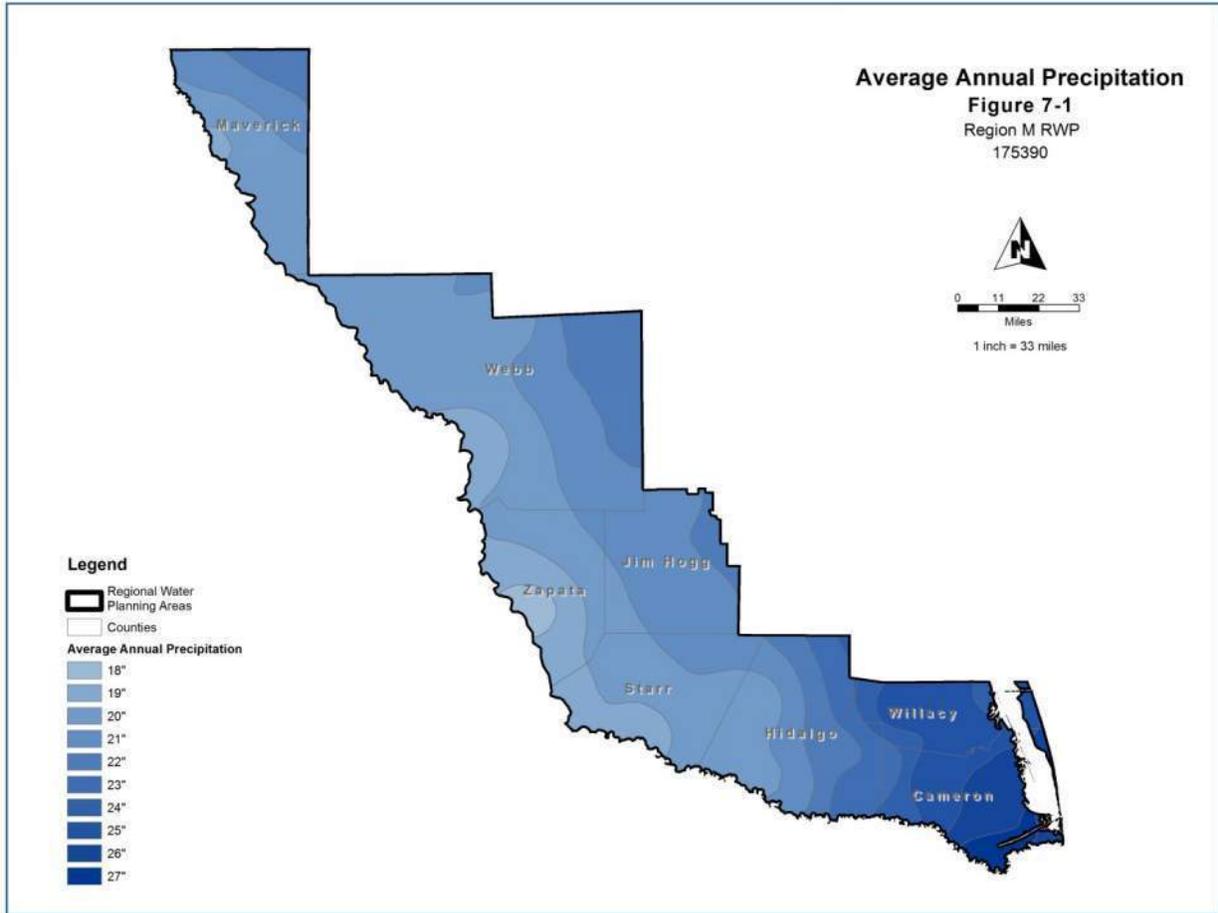


Figure 7-1 Average Annual Precipitation

Recently, the United States Bureau of Reclamation conducted a Basin Study for the Lower Rio Grande Valley, with the intent of understanding the potential impacts of climate change on the Rio Grande system.¹ The *Lower Rio Grande Basin Study* modeled a range of climate scenarios across the region, varying precipitation and temperature metrics. The Study conclusion was that the median climate scenario represented an average reduction in availability from the Amistad-Falcon Reservoir system of approximately 86,400 acre-ft./year by 2060. This reduction of average yield is not comparable to firm yield, but does give a sense of the potential impacts of increased temperatures and reduced flows. In addition to general predicted reduction of availability, most climate data indicate increased variability over the planning horizon, which presents another challenge to the region.

¹ Lower Rio Grande Basin Study, Under the Authority of the SECURE Water Act (Public Law 111-11) Great Plains Region, Oklahoma-Texas Area Office of the United States Bureau of Reclamation, December, 2013.

7.3 Current Drought Preparations and Response

Statewide, there have been increased efforts in recent years to establish both long-term drought management strategies to avoid shortages, and Drought Contingency Plans (DCP) to plan for temporary water supply shortages and other water supply emergencies.

TCEQ requires that anyone applying for a water right, irrigation districts, wholesale public water suppliers, and all retail public water suppliers serving 3,300 connections or more submit a DCP to the TCEQ. Public water suppliers serving less than 3,300 connections are required to have a DCP on file, but are not required to submit it to TCEQ. May 1, 2014 was the most recent deadline for DCP submittals.

All of the entities that are required to submit DCP, as well as all users of 1,000 acre-feet or more domestic, municipal, or industrial (DMI) surface water rights and 10,000 acre-feet or more of irrigation surface water rights, are required to submit a Water Conservation Plan (WCP) to TCEQ and TWDB.

Because of these requirements and recent drought conditions, many communities in the Rio Grande Region have addressed drought preparedness and water conservation planning. A complete list of the DCP and WCP that have been submitted to TCEQ at this time is shown in Table 7-1.

Drought contingency plans for retail or wholesale water suppliers are required to include the following:

- Specific, quantified targets for water use reductions
- Drought response stages
- Triggers to begin and end each stage
- Supply management measures
- Demand management measures
- Descriptions of drought indicators
- Notification procedures
- Enforcement procedures
- Procedures for granting exceptions
- Public input to the plan
- Ongoing public education
- Adoption of plan
- Coordination with regional water planning group

Table 7-1 Submitted Water Conservation and Drought Contingency Plans

Entity	Water Conservation Plan	Drought Contingency Plan
Adams Garden Irrigation District	✓	✓
Agua Special Utility District	✓	✓
City of Alamo		✓

Drought Preparations and Response - Current Drought Preparations and Response

Entity	Water Conservation Plan	Drought Contingency Plan
Brownsville Irrigation District	✓	✓
Brownsville Public Utilities Board	✓	✓
Cameron County Irrigation District No. 2	✓	
Cameron County Irrigation District No. 16		✓
Delta Lake Irrigation District	✓	✓
City of Donna		✓
Eagle Pass Water Works System	✓	✓
East Rio Hondo Water Supply Corporation	✓	✓
Harlingen Irrigation District	✓	✓
Harlingen Waterworks System	✓	✓
Hidalgo Co. Drainage District No. 1	✓	✓
Hidalgo Co. Irrigation District No. 1		✓
Hidalgo Co. Irrigation District No. 16	✓	✓
Hidalgo Co. Irrigation District No. 2	✓	✓
Hidalgo Co. Irrigation District No. 3	✓	✓
Hidalgo Co. Irrigation District No. 5	✓	✓
Hidalgo Co. Irrigation District No. 6	✓	✓
Hidalgo Water Improvement District No. 3	✓	✓
La Feria Irrigation District		✓
Laguna Madre Water District	✓	✓
City of Laredo	✓	✓
City of Lyford		✓
Maverick County Water Control and Improvement District No. 1	✓	✓
City of McAllen, McAllen Public Utility	✓	✓
Military Highway Water Supply Corporation	✓	✓
North Alamo Water Supply Corporation	✓	✓
North Cameron Regional Water Supply Corporation		✓
Pharr	✓	✓
Raymondville	✓	✓
City of Rio Grande City		✓
City of Roma	✓	✓
San Benito	✓	✓
San Juan	✓	
San Ygnacio Municipal Utility District		✓
Southmost Regional Water Authority	✓	✓
United Irrigation district	✓	✓
Union Water Supply Corporation		✓
Valley Municipal Utility District No. 2		✓
City of Weslaco	✓	✓
Zapata County Waterworks	✓	✓

7.3.1 Region M Drought Contingency Plans

The drought response varies from entity to entity, primarily between those who serve customers, including irrigators, with raw water, and those who deliver treated water. For Irrigation Districts, the response to drought is built into the allocation system, and how irrigation water rights are fulfilled by the Rio Grande Watermaster when supplies are limited. For treated water suppliers, triggers are specific to their users’ demand in relation to treatment capacity or DMI water rights held.

Irrigation Districts

The TCEQ Rio Grande operating rules determine how the United States’ share of surface water stored in Amistad and Falcon Reservoirs is apportioned among the various WUGs in the Region M planning area. A storage pool within the reservoir of 225,000 acre-ft. is replenished at the beginning of each month to fulfill Domestic, Municipal and Industrial (DMI) water rights, so an entity that holds a DMI water right can request water that remains in their water right account balance. Class A and B irrigation and mining water rights are allotted what remains on their account balances if there is sufficient water in the reservoir after the DMI storage pool and reservoir operating requirements are met. In the history of the Watermaster Program, the DMI reserves have always been replenished in full, but the pool of water available for Class A and B water rights is often significantly less than what would be required to fulfill the maximum authorization of all of those water rights. Class A and B water rights absorb the impacts of drought on the reservoir system by having water rights that are less than 100% reliable.

At the Irrigation District level, irrigation and mining (and multi-use water rights, which are allocated similarly but have the flexibility to be used for irrigation or mining uses) are delivered as requested to end users. The majority of Rio Grande irrigation water rights are owned by Irrigation Districts. Farmers pay an annual flat rate assessment which entitles them to receive irrigation water based on acreage. Each water district has slightly different rules on allocation, in some cases allowing water to be sold between farmers in their district or permitting a farmer to consolidate their allocation on a portion of their land, leaving other areas for dry land farming. These measures allow farmers to adjust their crop selection if water shortages are anticipated.

A summary of the drought triggers and responses as listed by the Irrigation Districts that had submitted DCPs at the time of writing is shown in Table 7-2.

Table 7-2 Summary of Irrigation District Drought Triggers and Responses

Entity	Date		
Adams Garden	11-Aug-09	TRIGGERS:	Water Allocations for irrigators go into effect as determined by the Board of the District.
		ACTIONS:	The total water allocated to the Irrigation District by the Watermaster will be divided among flat-rate customers according to their account balance.
Brownsville	23-Apr-14	TRIGGERS:	Water assignments are initiated upon approval of the Board.

Entity	Date		
Irrigation District		ACTIONS:	Each irrigation user shall be assigned 3 irrigations or 1 acre-foot of water for each acre planted in the previous year. As additional water supplies become available to the District, water will be equally distributed as described in Section 11.039 of the Texas Water Code.
Cameron County Irrigation District No. 2	25-Apr-14	TRIGGERS:	Water Allocations for irrigators go into effect as determined by the Board of the District.
		ACTIONS:	The total water allocated to the Irrigation District by the Watermaster will be divided among flat-rate customers evenly so that no one user can irrigate more than their portion.
Cameron County Irrigation District No. 16	7-May-14	TRIGGERS:	Upon approval of the board, water allocation will become effective when the storage balance in the district's irrigation water rights account reaches 1500 acre-feet.
		ACTIONS:	Each irrigation user shall be allocated 3 irrigations or 2 acre-feet of water for each flat rate acre. Additional water available to the District will be equally distributed, on a pro rata basis, to users having an account balance of less than 1 acre-feet of water for each flat rate acre. Transfers of allotments within the District are allowed.
Delta Lake Irrigation District	16-Apr-14	TRIGGERS:	Upon approval of the board, water allocation will become effective when the storage balance in the district's irrigation water rights account reaches 60,000 acre-feet.
		ACTIONS:	Each irrigation user shall be allocated 3 irrigations or 2 acre-feet of water for each flat rate acre. Additional water available to the District will be equally distributed, on a pro rata basis, to users having an account balance of less than 1 acre-feet of water for each flat rate acre. Transfers of allotments within the District are allowed.
Harlingen ID	11-Aug -09	TRIGGERS:	Water Allocations for irrigators go into effect when either a) the storage balance in the district's irrigation water rights account has declined to one irrigation-per-acre level, or b) the Board determines that there is not sufficient water to complete the traditional crop year.
		ACTIONS:	The total water allocated to the Irrigation District by the Watermaster will be divided among flat-rate customers evenly so that no one user can irrigate more than their portion.
Hidalgo Co. Irrigation District No. 1	22-Feb-07	TRIGGERS:	When the watermaster initiates diversions based on allocations, the District's Board of Directors determines the total allocation available to the District and stored in the Falcon/Amistad Reservoir System is less than 2.5 acre-feet/year of the estimated active parcels of land.

Entity	Date		
		ACTIONS:	The District initiates allocation of water to active irrigation users, on a pro-rata basis provided that no parcel receives an allocation which will result in an account balance exceeding 1.83 acre-feet per acre.
Hidalgo Co. Irrigation District No. 3	17-Oct-14		<p>Upon approval of the Board, water allocation will go into effect when the District's total water right from the Rio Grande Watermaster amounts to less than one year supply as determined by the Board.</p> <p>Water is pro-rated to irrigable land on which all flat rate assessment is paid in accordance with the District's Water Allocation Program. Additional water will be equally distributed, on a pro-rata acreage basis. When the Water Allocation Program is in effect, the District will not supply Out of District water except in accordance with policy adopted as a result of U.S. Bureau of Reclamation WaterSMART Grant.</p>
Hidalgo Co. Irrigation District No. 5	6-Jul-05	TRIGGERS:	Upon approval of the Board, water allocation will become effective when the water allocated to HCID#5 for irrigation by the Rio Grande Watermaster amounts to 2½ acre-feet per compliant acre or less.
		ACTIONS:	Water will be allocated on a pro rata per acre basis to the compliant acreage.
Hidalgo Co. Irrigation District No. 6	6-Jul-05	TRIGGERS:	Upon approval of the Board, water allocation will become effective when the water allocated to HCID#6 for irrigation by the Rio Grande Watermaster amounts to 2½ acre-feet per compliant acre or less.
		ACTIONS:	Water will be allocated on a pro rata per acre basis to the compliant acreage. Transfers of allotments within (but not outside) the District, with the consent of the allotted, will be permitted.
La Feria Irrigation District	1-Sep-14	TRIGGERS:	Upon approval of the Board, water allocation becomes effective when the storage balance in the water rights account reaches an amount less than or equal to 2 irrigations for each flat rate acre.
		ACTIONS:	Each user is allocated 1 irrigation or 1 acre foot of water, if metered, for each flat rate acre. Transfer within the District is allowed. Transfer from outside of the District to a user in the District is allowed.

Retail Public Water Suppliers

Although a few cities rely on groundwater exclusively or have groundwater comprising a part of their supply, most cities in Region M rely on surface water from the Rio Grande. Because the availability of municipal water rights are granted first priority from the Amistad-Falcon

Reservoir system, these water rights have historically been considered “guaranteed” in their full authorized diversion volume.

Those entities who deliver treated water generally developed triggers that were either based on the remaining municipal water rights available to the city for that year or the capacities of their treatment plants, such that high demands on the plants trigger a conservation stage. The conditions of the reservoirs are occasionally listed among triggers in public water supply DCPs, but have little bearing on the availability of municipal water. The conservation stages for cities included limitations on car washing and lawn watering, ranging from voluntary in early stages to assessed fines or other penalties in later stages.

A summary of the DCPs available for cities and water supply corporations at the time of writing is included as Appendix E, and summary tables for some of the larger systems are shown in Table 7-3 through Table 7-9. Additional information and model DCPs can be found on the TCEQ website at https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/contingency.html.

Table 7-3 East Rio Hondo Water Supply Corporation Drought Response

East Rio Hondo Water Supply Corporation		1-May-14
Basis of Drought	Reservoir level, irrigation district notice to disallow irrigation, water demand, system break/failure or contamination, distribution system pressure	
Drought Stage	TRIGGERS:	ACTIONS:
Stage 1	Falcon and Amistad Reservoirs reach 40% of capacity as determined by the TCEQ	Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses.
Stage 2	a) Cameron County Irrigation District No. 2 or other IDs provide notice to ERHWSC that they will disallow farm irrigation water use within 60-90 days, b) distribution system pressures fall below 35 psi requirements for two consecutive days, c) ERHWSC consumer demand exceeds 85% of ERHWSC plant capacity for 15 days out of any consecutive 30 day period, or d) Falcon and Amistad Reservoirs reach 15% of capacity as determined by TCEQ.	Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses, such as irrigation, washing vehicles, and ornamental fountains and ponds.
Stage 3	a) Major water line breaks, or pump or system failures occur, which cause loss of capability to provide water service, b) natural or man-made contamination of the water supply source(s), c) rapidly occurring low-pressure conditions (less than 20 psi) due to any reason.	All requirements of Stage 2 shall remain in effect, except the following are prohibited: all irrigation of landscape, using water to wash any vehicle, and adding water to any type of pool.

Table 7-4 Brownsville Public Utilities Board Drought Response

Brownsville Public Utilities Board		1-May-14
Basis of Drought	Time of year, reservoir level, system break/failure or contamination, water demand/WTP capacity, projected water demand	
Drought Stage	TRIGGERS:	ACTIONS:
Stage 1	Automatically initiated on May 1 of each year and for any of the following: a) Rio Grande Watermaster advises that a water shortage is possible due to low levels in Amistad and Falcon reservoirs, b) level of U.S.' water in Amistad and Falcon reservoirs reaches 51%, c) line break, pump, or system failure may result in unprecedented loss of capability to provide service, or d) peak demand on the distribution system and/or treatment plants is nearing capacity limits	Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses.
Stage 2	a) Level of U.S.' water in Amistad and Falcon reservoirs reaches 25%, b) analyses of water supply and demand indicate that the annual water allotment may be exhausted, c) line break or pump, or system failure will result in unprecedented loss of capability to provide service, d) peak demands on the distribution system and/or treatment plants are nearing capacity levels, or e) contamination of the water supply and/or transmission system may result in unprecedented loss of capability to provide service	Customers shall only be allowed to irrigate and wash vehicles following a certain schedule, golf courses shall follow restrictions in their approved water management plans, restaurants may only serve water to customers upon request, and the following are prohibited unless necessary for public health and safety: washing hard-surfaced areas, washing buildings or structures, using water for dust control, flushing gutters, and failing to repair controllable leaks within a reasonable period of time
Stage 3	a) Level of U.S.' water in Amistad and Falcon reservoirs reaches 15%, b) analyses of water supply and demand indicate the annual water allotment will be exhausted, c) major line break, or pump or system failure may result in unprecedented loss of capability to provide service, d) peak demand on the distribution system and/or treatment plants has exceeded capacity levels for three days, e) contamination of the water supply and/or transmission system will result in unprecedented loss of capability to provide service, or f) the inability to maintain or replenish adequate volumes of water in storage to provide for public health and safety	All requirements of Stage 2 shall remain in effect and in addition the schedule irrigation and vehicle washing will be further restricted, the use of water from hydrants is only allowed when necessary to maintain public health, safety, and/or welfare, and the following are prohibited: refilling outdoor pools (with some exceptions), operation of outdoor fountains or ponds without recirculation systems unless required to maintain aquatic life, hydrant and sewer flushing except for emergencies, and use of water from or pumping water into resacas
Stage 4	a) Major line breaks, or pump or system failures occur which cause unprecedented loss of capability to provide water service, or b) contamination of water supply and/or transmission system	All requirements of Stage 3 shall remain in effect and in addition the following are prohibited: all landscaping watering, use of water for construction purposes under special permit, adding water to swimming pools, adding water to any outdoor or indoor fountain or pond, except to maintain aquatic life

Table 7-5 City of Laredo Drought Response

City of Laredo		1-May-14
Basis of Drought	Water demand/WTP capacity, reservoir level	
Drought Stage	TRIGGERS:	ACTIONS:
Stage 1	a) WTP flow is less than 85% capacity for 5 consecutive days, b) Amistad reservoir level reaches 51% capacity	Customer are asked to voluntarily reduce their water usage and the following are prohibited: allowing irrigation water to run off into a gutter, ditch, drain, street and failure to repair a controllable leak
Stage 2	a) WTP flow is at 85% capacity for 3 consecutive days, b) Amistad reservoir level reaches 25% capacity	All requirements for stage 1 remain in effect and the following are only allowed during certain scheduled times: irrigation with sprinkler systems, washing of vehicles, adding water to pools, irrigating parks/plazas/squares. The following are prohibited: operating any ornamental fountain or similar structure without a recycling system and washing paved areas, except to alleviate immediate fire hazards.
Stage 3	a) WTP flow is at 90% capacity for 1 day, b) Amistad reservoir level reaches 20% capacity	All requirements for stage 2 remain in effect, except the schedules to use water for certain activities are even stricter and irrigating athletic fields is also held to a certain schedule. No bulk water sales will be made by the City when the water will be transported outside of the City except for domestic/residential/livestock use. Fire hydrant water sales shall cease.
Stage 4	a) WTP flow is at 95% capacity for 1 day, b) Amistad reservoir level is less than 20% capacity	All requirements for stage 3 remain in effect and no applications for new or expanded water service connections will be approved without permission from the Utilities Director, water delivered to non-essential industrial and commercial customers will be reduced, and a maximum monthly water use allocation may be established for residential customers. The following are prohibited: irrigation, washing vehicles, adding water to pools.

Table 7-6 McAllen Public Utility Drought Response

McAllen Public Utility		25-Feb-13
Basis Of Drought	Water Treatment plant capacity being used, reservoir levels, system outages or failures.	
Drought Stage	TRIGGERS:	ACTIONS:
Stage 1	In effect at all times	Customers asked to voluntarily limit water use to an amount absolutely necessary for health, business, and irrigation.
Stage 2	1. Demand reaches or exceeds 85% of capacity for 3 consecutive days 2. Amistad-Falcon reservoirs reach 40% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	The following are restricted: Irrigation, but drip method or hand-held buckets permitted at any time; washing motor vehicles, except commercial carwashes or service stations; washing or sprinkling foundations; adding water to swimming pools; operation of fountains or ponds, except with a recycling system; irrigation for golf courses, except those using wastewater effluent; hydrants restricted to firefighting and necessary activities. The following are absolutely prohibited: allowing irrigation water to run off into gutter, ditch, or drain; failure to repair controllable leaks; washing paved surfaces.
Stage 3	1. Demand reaches or exceeds 90% of capacity for 3 consecutive days 2. Amistad-Falcon reservoirs reach 25% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	All stage 2 restrictions except: further restrictions on means and schedule for irrigation, except by drip or hand-held buckets; watering of golf fairways is prohibited unless with wastewater effluent, reused water, or well water; customers to pay a water surcharge.
Stage 4	1. Demand reaches or exceeds 95% of capacity for 3 consecutive days 2. Amistad-Falcon reservoirs reach 20% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	All stage 2 and 3 restrictions except: further restrictions on means and schedule for irrigation; washing of motor vehicles not occurring on commercial carwashes and not in the immediate interest of public health and safety is prohibited; carwashes in the interest of public health and safety limited to 50% of monthly average; commercial nurseries, sod farmers, etc. limited to means and schedule restrictions; adding water to pools, except to maintain structural integrity, is prohibited; operation of fountains prohibited; customers to pay a water surcharge.
Stage 5	1. Demand reaches or exceeds 100% of capacity 2. Amistad-Falcon reservoirs reach 15% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	All stage 2, 3, and 4 restrictions except: no applications for new, additional, or expanded water connections, lines, etc. are allowed except as approved by PUB; water allocations to non-essential customers reduced as established by the PUB; max monthly water allocation for residential customers established with revised rate schedules and penalties by the PUB; irrigation permitted only by handheld hoses, handheld faucet filled buckets; drip irrigation on set schedule; customers to pay a water surcharge.

Table 7-7 North Cameron Regional Water Supply Corporation Drought Response

North Cameron Regional Water Supply Corporation		11-Sep-14
Basis Of Drought	Water storage tank levels, production capacity.	
Drought Stage	TRIGGERS:	ACTIONS:
Stage 1	North Cameron Regional Water Plant (NCRWP) ground storage tank falls below 50% capacity.	Request wholesale water customers initiate voluntary measure to reduce water use.
Stage 2	NCRWP ground storage tank falls to 25% capacity.	<ul style="list-style-type: none"> a) Discuss water supply/demand conditions with customers and request they initiate measures to reduce water use b) Implement pro rata curtailment of water diversions and/or deliveries to add 50,000 gallons per day to storage tank
Stage 3	NCRWP ground storage tank falls to 10% capacity.	<ul style="list-style-type: none"> a) Increase water blend ratios if possible, not exceeding 1000 ppm TDS b) Discuss water supply/demand conditions with customers and request they initiate measures to reduce water use and utilize alternative water supplies c) Implement pro rata curtailment of water diversions and/or deliveries to add 75,000 gallons per day to storage tank
Stage 4	NCRWP has no production capacity.	<ul style="list-style-type: none"> a) Notify customers of the need to switch to alternate water supplies b) If appropriate, notify member, county, and/or state emergency response officials c) Undertake necessary actions, including repairs and/or clean-up as needed. d) Prepare post-event assessment report on incident and critique of emergency response procedures

Table 7-8 Southmost Regional Water Authority Drought Response

Southmost Regional Water Authority		1-May-14
Basis Of Drought	Time of year, reservoir levels, system malfunction or failure, contamination of water.	
Drought Stage	TRIGGERS:	ACTIONS:
Stage 1	Automatically initiated from May 1 to Sept. 30 of each year or if one or more of the following occur: 1. Watermaster advises the Brownsville PUB that a water shortage is possible. 2. Level of Amistad and Falcon Reservoirs reaches 51% or 1.66 million acre-feet. 3. Line breaks or system failures cause loss of service. 4. WTP is nearing capacity levels	Customers asked to voluntarily conserve water and adhere to the following restrictions: restrict means and/or schedule of irrigation of landscaped areas; minimize or discontinue use of non-essential purposes; and reduce fire hydrant and sewer line flushing.

Stage 2	1. Level of Amistad and Falcon Reservoirs reaches 25% or 834,600 acre-feet. 2. Line breaks or system failures cause loss of service. 3. Demands on Brownsville PUB distribution and/or WTPs near capacity levels. 4. Contamination of water supply or distribution system causes loss of service.	All Stage 1 restrictions in effect and any or all of the following restrictions: means and schedule of landscape irrigation restricted further; means and schedule of washing motor vehicles, boats, planes, etc. restricted; water use for golf courses based on water mgmt. plan; restaurants prohibited from serving water unless requested; all non-essential uses prohibited.
Stage 3	1. Level of Amistad and Falcon reservoirs reaches 15% or 504,600 acre-feet 2. Line breaks or system failures cause loss of service 3. Demands on SRWA's distribution and/or WTP exceed capacity for 3 days 4. Contamination of water supply or distribution system causes loss of service 5. Inability to maintain or replenish water in storage for public health and safety.	All Stage 1 and 2 restrictions and any or all of the following: means and schedule of landscape irrigation and residential car washing restricted further; water from hydrants limited to firefighting or other activities necessary to maintain public health and safety or for construction under special permit; filling swimming pools prohibited; operation of fountain or pond prohibited except for aquatic life; hydrant and sewer line flushing permitted only for emergency; use of water for scenic and recreational ponds and lakes prohibited.
Stage 4	1. Line breaks or system failures cause loss of service 2. Contamination of water supply and/or distribution system.	All Stage 1, 2, and 3 restrictions remain in effect and any or all of the following: all landscape watering is prohibited; use of water for construction under special permit prohibited; washing of motor vehicles, boats, planes, etc. prohibited; filling of pools to a maintenance level is prohibited; water for maintenance level of fountains or ponds except to support aquatic life is prohibited. Water rationing can be initiated with any or all of Stage 4 restrictions

Table 7-9 City of Weslaco Drought Response

City of Weslaco		1-May-09
Basis Of Drought	Reservoir level, projected water demand, system break/failure	
Drought Stage	TRIGGERS:	ACTIONS:
Stage 1	a) Level of U.S. waters in Amistad and Falcon reservoirs reaches 51%, b) water demand projections for the year suggest available water rights may be used at 95%	Request customers to voluntarily reduce water usage
Stage 2	a) Level of U.S. water in Amistad and Falcon reservoirs reaches 25%, b) a condition causes system-wide problems so the normal level of water service may be diminished for a period of time, c) water demand projections for the year suggest available water rights may be used at 98%	The means and/or schedule for the following will be restricted: watering of grass and vegetation, washing of vehicles, adding water to pools, and irrigating golf courses. The following are prohibited: allowing water to run off into gutters or streets, washing of buildings, trailers, railroad cars, maintaining defective home plumbing, use of hydrants except for firefighting, ornamental fountain without recirculation, use of water to wash down hard surfaced area, and use of water for dust control.

Stage 3	a) Level of U.S. water in Amistad and Flacon reservoirs reaches 15%, b) a condition related to extraordinary circumstances severely and immediately diminish the ability to deliver a normal level of water, c) water demand projections for the year suggest available water rights may be used at 100%	The following are prohibited: new service connections to the water system if another water source is already used, serving restaurant customers water when they do not ask for it, use of water for scenic and recreational ponds or lakes, use of water for pools, use of water to put new agricultural land into production, use of water for new planting or landscaping, and acceptance of applications for new or extended water service connections without approval by City. Industrial and commercial users must implement an individual curtailment plan and residential customers will receive a maximum monthly usage amount.
----------------	--	--

7.3.2 Existing and Potential Emergency Interconnects

In accordance with Texas Administrative Code (31 TAC 357.42(d)) the RWPG has collected confidential information on existing interconnects. The majority of water users in Region M are located along the Rio Grande, or along canals that convey Rio Grande water. In a sense, the region is highly inter-connected. The distribution system for raw Rio Grande water includes the reservoir system and the 27 Irrigation Districts, many of which are either interconnected or have high potential to be connected. The RWPG has reached out through representatives of the Lower Rio Grande Valley Water District Managers Association to the District managers for information about interconnects between raw water systems.

Municipal utilities supplying treated water to retail customers are becoming more interconnected across the region. In order to evaluate current connections between systems, the Region M Planning Group appointed a selection of members to a Drought Response Committee. This committee met a number of times to collect and evaluate information about drought response plans and interconnects. Members of this committee requested information about interconnects from the South Texas Water Utilities Manager Association for entities in Cameron and Hidalgo Counties, and all utilities in the other six counties were contacted individually. Although utilization of emergency interconnects was not included in the DCP that were reviewed, Table 7-10 shows known interconnections between public water supply systems and whether the connections are used for regular service or only in emergencies. Detailed confidential information about these interconnections was submitted securely to the Executive Administrator of the TWDB.

Table 7-10 Emergency Interconnections between Public Water Supply Systems

Public Water Supply System	Interconnects	Type of Connection
Agua SUD	La Joya Peñitas, Palmview, Sullivan City, Mission	One-way emergency interconnect All within Agua SUD service area
East Rio Hondo WSC	Harlingen WW City of Los Fresnos Olmito WSC North Cameron Regional	Connection for Regular Service with capacity to increase in emergencies Connection for Regular Service Connection for Regular Service with capacity to increase in emergencies Connection for Regular Service

Public Water Supply System	Interconnects	Type of Connection
	Combes	Emergency Interconnect
Harlingen Waterworks	City of La Feria	Emergency Interconnect
	City of Combes	5 Connections for Regular Service
	City of Primera	2 Connections for Regular Service
	City of San Benito	Emergency Interconnect
	City of Palm Valley	2 Connections for Regular Service
	East Rio Hondo WSC	Connection for Regular Service
	Military Highway WSC	Connection for Regular Service
City of McAllen	Edinburg	Used only during times of high demand.
	Pharr	Used only during times of high demand.
	Mission	Used only during times of high demand.
	Hidalgo	Used only during times of high demand.
	HCID No. 2, HCWID No. 3, United ID	McAllen receives raw water from these Districts
Military Highway WSC	Harlingen WW (see above)	
	Los Indios, Progreso, San Juan	Military Highway serves these entities
North Alamo WSC	City of Mercedes	Emergency Interconnect
	Sebastian MUD	Emergency Interconnect
	City of Lyford	Emergency Interconnect
	City of Raymondville	Emergency Interconnect
	City of Edcouch	Emergency Interconnect
	City of Elsa	Emergency Interconnect
	City of La Villa	Emergency Interconnect
	City of Donna	Connection for Regular Service
	City of Edinburg	2 Connections for Regular Service
	Military Highway WSC	Connection for Regular Service
	Quiet Village Utilities	Connection for Regular Service
	Port Mansfield PUB	Connection for Regular Service
	Delta Lake ID, Donna ID, HCID No.2, HCID No. 1, ERHWS	NAWSC receives raw water from these Districts
	Olmito WSC	Los Fresnos
Valley MUD #2		Two-Way Emergency Interconnect
Zapata County Waterworks	Zapata Co. WCID #16	Connection for Regular Service
Brownsville PUB	Brownsville, El Jardin WSC	Connection for Regular Service
Laguna Madre Water District	Laguna Vista, Port Isabel, South Padre Island	All within Laguna Madre Water District's service area
Valley MUD #2	Military Highway WSC	Emergency Interconnect
	Olmito WSC	Emergency Interconnect
	Southmost Regional Water Authority	Connection for Regular Service
	Rancho Viejo	Connection for Regular Service
Rio Grande City	Rio WSC	Connection for Regular Service
City of Roma	Escobares	Connection for Regular Service
Weslaco	Mercedes	Emergency Interconnect

7.4 Emergency Responses to Local Drought or Loss of Municipal Supply

Municipal WUGs that are of particular concern for emergency drought response are identified as those that have a population of 7,500 or less and have a sole-source of water, even if that water is provided by a WWP or, in the case of the Rio Grande region, if those entities receive waters from the Rio Grande from multiple Irrigation Districts. Additionally, all County-Other WUGs are considered.

WUGs that meet these criteria are shown in Table 7-11, with the 2010 Census population and current suppliers. Most of these districts rely exclusively on water from the Rio Grande system, and have no secondary source available to them (the Districts that provide Rio Grande surface water are listed as the Current Supply). Those that indicate their sole supply is groundwater are generally geographically constrained, and limited to local groundwater supplies.

Table 7-11 WUGs Identified for Emergency Drought Response Evaluation

County	Entity	Census Population 2010	Current Supply (1)	Current Supply (2)
Cameron	Combes	2,895	La Feria ID	
Cameron	County-Other	44,311	Surface Water (various)	Groundwater (various)
Cameron	La Feria	7,302	La Feria ID	
Cameron	Laguna Vista	3,117	Laguna Madre WD	*limited non-potable reuse avail
Cameron	Olmito WSC	3,361	CCID 6	
Cameron	Palm Valley	1,304	Harlingen ID 1	
Cameron	Port Isabel	5,006	Laguna Madre WD	*limited non-potable reuse avail
Cameron	Rio Hondo	2,356	CCID 2	
Cameron	Santa Rosa	2,873	La Feria ID	
Cameron	South Padre Island	2,816	Laguna Madre WD	
Hidalgo	County-Other	32,223	Surface Water (various)	Groundwater (various)
Hidalgo	Edcouch	3,161	HCCID 9	
Hidalgo	Elsa	5,660	HCCID 9	
Hidalgo	Hidalgo County MUD #1	5,412	HCID 1	
Hidalgo	La Villa	1,957	HCCID 9	
Hidalgo	Palmhurst	2,607	Sharyland WSC	
Hidalgo	Palmview	5,460	Agua SUD	
Hidalgo	Penitas	4,403	Agua SUD	
Hidalgo	Sullivan City	4,002	Agua SUD	
Jim Hogg	County-Other	742	Local Groundwater	
Jim Hogg	Hebbronville	4,558	Gulf Coast GW	
Maverick	County-Other	28,010	Surface Water (various)	Groundwater (various)
Starr	Agua SUD	254	HCID 6	HCID 16
Starr	County-Other	24,657	Surface Water (various)	Groundwater (various)
Starr	Escobares	1,188	City of Roma	
Starr	La Grulla	1,622	Direct RG	
Starr	Rio WSC	3,298	Self-supplied SW	Rio Grande City
Starr	Union WSC	6,350	United ID	HCID 2
Webb	County-Other	6,146	Surface Water (various)	Groundwater (various)

County	Entity	Census Population 2010	Current Supply (1)	Current Supply (2)
Webb	El Cenizo	3,273	Webb CO Water Utility	
Webb	Rio Bravo	4,794	Webb CO Water Utility	
Willacy	County-Other	468	Surface Water (various)	Groundwater (various)
Willacy	Lyford	2,611	Delta Lake ID	
Willacy	Sebastian Mud	1,834	La Feria	
Zapata	County-Other	2,321	Surface Water (various)	Groundwater (various)
Zapata	San Ygnacio MUD	835	Self-supplied SW	

Emergency shortage response recommendations for the entities listed above are separated into those with surface water as the sole source, and those with groundwater as the sole source. County-Other users that do not qualify as WUGs individually, are likely to fall into either the groundwater or surface water dependent categories.

Sole Source: Surface Water

Entities that depend entirely on Surface water in Region M are very common. If shortages are experienced in one location as a result of insufficient water rights to meet demand or to deliver water, there is a water market and provisions that allow for entities in an emergency to purchase emergency water. Purchase of emergency water may be expensive and insufficient water rights may cause supply uncertainty in a city or utility service area. It is therefore recommended that entities purchase water rights when feasible.

Interconnections between utilities will build greater resilience into the Region’s utilities by providing an alternate source of treated water if either system is damaged or fails. Entities that experience push-water requirements when irrigation deliveries are curtailed may also benefit from both raw and treated water interconnects, which could allow districts and utilities to coordinate and consolidate deliveries in a limited number of canals.

Any emergency that impacts the quality of the water in the Rio Grande has the potential to cause significant harm to the region. Because contamination could come from either the U.S. or Mexican side of the river, there is an additional level of uncertainty regarding potential contaminants. This limits the ability of the region to prepare for this kind of event and may also limit the ability to respond quickly. In the past, there have been releases into the Rio Grande that were only identified by a widespread fish kill. There is currently no emergency response plan in place to handle the release of contaminants into the Rio Grande.

A release in April of 2014 on the Rio Salado (a Rio Grande tributary in Mexico) was identified by the Mexican counterpart to the International Boundary Water Commission (IBWC), the Comision Internacional de Limites y Aguas, which reported that a release had occurred, but the quantity and the material were unknown.² Later information showed that the release was on April 8, but the notification was not until April 30th.

² Taylor, Steve. “Darling: Fish Kill Highlights Need For Rio Grande Emergency Plan” Rio Grande Guardian, March 14, 2014. <http://riograndeguardian.com/darling-fish-kill-highlights-need-for-rio-grande-emergency-plan/>, accessed April 6, 2015.

TCEQ conducted testing on the Rio Grande upstream and downstream of the inflows from the Rio Salado, which took five days to analyze. In this case, the results of broad-spectrum pollutant analysis showed that there were no contaminants that could endanger human health, and other contaminants of concern, like heavy metals, were beneath federal and state limits for drinking water. However, this incident drew attention to the lack of emergency planning for the Region.

Regular water quality testing and reporting is already in place in some locations to alert farmers of high Total Dissolved Solids (TDS) in the river. This type of system could be expanded upon to provide regular reports of water quality to utility managers and agencies like IBWC and TCEQ. This kind of water quality analysis is complicated by the fact that the potential contaminants are not known in many cases. Understanding the timing of contaminant transport through the system could allow entities to pump enough water to fill reservoirs before the contaminant has reached that location. However, the success of this approach is contingent on timely information about releases. At a minimum, information must be communicated to utilities and to the public in an accurate and timely manner so that safe drinking water can be provided immediately.

Long-term recommendations for entities that rely solely on surface water include expansion of alternate water supplies, including fresh and brackish groundwater where available. Emergency recommendations are listed below in Table 7-12.

Table 7-12 Emergency Water Shortage Responses: Surface Water Dependent WUGs

Emergency Shortage	Responses
Insufficient Surface Water Rights	Purchase surface water, highest stage drought restrictions
Water Treatment Plant Failure	Interconnects with other systems, truck in water, highest stage drought restrictions
Rio Grande Contamination	Immediate testing, Pumping and storage of safe water, interconnects with systems that have alternate supplies, truck in water, boil notice to customers, highest stage drought restrictions

Sole Source: Groundwater

Utilities that depend exclusively on groundwater tend to be more isolated from other sources and other cities. For instance, Hebbronville is over 30 miles from the nearest city, Falfurrias. For entities that are dependent on groundwater, it is encouraged that the entity actively monitor water levels in wells, especially in high-demand periods. Water levels can be used to trigger drought responses, and to guide expansion of wellfields or deepening of wells. Additionally, groundwater quality may be an indicator of decreasing availability from a well or wellfield.

Emergency responses for entities that rely solely on groundwater are shown in Table 7-13.

Table 7-13 Emergency Water Shortage Responses: Groundwater Dependent WUGs

Emergency Shortage	Responses
Insufficient Well Production	Highest stage drought restrictions Deepen wells (if possible) Interconnects with other systems (if possible) Truck in water
Water Treatment Plant Failure	Highest stage drought restrictions Interconnects with other systems (if possible) Truck in water
Groundwater Quality	Immediate testing Highest stage drought restrictions Additional emergency treatment (if possible) Truck in water

7.5 Region-Specific Drought Response Recommendations

Drought response recommendations are made for each water source below. Model Drought Contingency Plans are included for all WUG types in Appendix E.

7.5.1 Amistad-Falcon Reservoir System Drought Response Recommendations

Because DMI and Irrigation/Mining water rights are handled differently in the Amistad-Falcon Reservoir System, they are addressed separately here.

DMI Water Right Holders

Cities and industrial users in Region M experience drought under the following scenarios, described in Table 7-14 with recommendations specific to each.

Table 7-14 Municipal Shortage Scenarios and Recommendations

Shortage Scenario and Triggers	Recommended Responses
<p>Insufficient water rights to meet demand. An entity may have sufficient treatment capacity to meet their demands, but have insufficient water rights to meet drought year demands.</p> <p>Triggers should be based on useable balance calculations and monthly/weekly demand projections. When the balance of water available for the remainder of the year doesn't exceed the demand projections by a reasonable margin, severe drought response should be implemented. When the projected demands exceed the balance of water, critical drought response should be implemented.</p>	<p>Best Practices: Use of water rights should be managed carefully, and cities should track their useable balance over the year compared with seasonal/monthly demand projections. This will allow a city to implement conservation measures early in the year to stay within their water budget. It is recommended that any city that projects a shortage should purchase water rights when feasible.</p> <p>Severe Conditions: Request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, purchase water as it is available</p> <p>Critical Conditions: Implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, purchase water as it is available</p>

Shortage Scenario and Triggers	Recommended Responses
<p>Water treatment plant capacity. Municipal utilities with sufficient water rights may experience a shortage if, during their peak demand months, the capacity of the water treatment plant is not sufficient to meet permit requirements</p> <p>Triggers should be based on daily treatment volumes and TCEQ WTP capacity rules. When 85% capacity is reached for three consecutive days, severe drought response should be implemented. When 95% capacity is reached, critical drought response should be implemented.</p>	<p>Best Practices: Conservation programs can reduce demands on the water treatment plant. The long-term solution is expansion of water treatment plant(s) capacity and inter-connections with other facilities.</p> <p>Severe Conditions: Request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, utilize emergency interconnects</p> <p>Critical Conditions: Implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, utilize emergency interconnects</p>
<p>Push water. Even with sufficient water rights to meet demands and to cover normal delivery losses, some municipalities, especially those who receive surface water from Irrigation Districts that serve mostly irrigation water users, may need additional water to meet minimum operational requirements in the District conveyance system if irrigation water is curtailed.</p> <p>Triggers should be based on 1) the requirement of irrigation water to deliver DMI water in a given District, 2) the useable balance available to irrigators in the District, and whether those irrigators are on allocation, and 3) the storage capacity available to the utility.</p> <p>Severe drought restrictions should be implemented if stored water is at or within a small margin of the projected demands before the next feasible delivery from the district.</p> <p>Critical drought restrictions should be implemented if water in storage is less than the projected demands before the next feasible delivery from the district.</p>	<p>Best Practices: First, utilities should have a clear communication plan in place with the Irrigation District that alerts the city when irrigation water users may be put on allocation. This may include a drought trigger associated with Amistad/Falcon reservoir storage levels and the useable balance of irrigation accounts in the District. Second, utilities should evaluate their current conveyance methods to see if there are alternate canals or districts which may be able to serve their systems in the case of a push water shortage. Third, where possible, entities should increase their raw water storage to allow for more time between deliveries that need to be timed to coincide with irrigation deliveries. Lastly, interconnections and emergency agreements with other utilities and other sources are recommended.</p> <p>Severe Conditions: Request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, utilize emergency interconnects, identify water that may be available for purchase as push water</p> <p>Critical Conditions: Implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, utilize emergency interconnects, identify water that may be available for purchase as push water</p>

Irrigation and Mining Water Right Holders

Farmers can respond to drought through planning, crop selection, highly efficient operations, and on-farm demand reduction strategies (like narrow border citrus and drip irrigation). Farmers and Irrigation Districts should maintain useable balance calculations and monitor reservoir levels in order to facilitate planning. Selection of crops, in conjunction with available demand reduction strategies, can allow for farmers to maximize their yield in years of drought. Crop selection tools that take current costs and market values into account have been made available to farmers in the high plains, and could be updated with information specific to the Region.

Cooperation with the Irrigation Districts to increase the operational and conveyance efficiency could yield a significant amount of water to farmers. This is discussed as a Water Management Strategy in Chapter 5.

Mining water use, including oil and gas drilling, can be decreased by close controls of leaks and spills, on-site reuse, and new technology or approaches that require less water. Because mining water rights are subject to the same decrease in reliability in drought years, it is highly encouraged that mining water users identify and implement water conservation measures. Both Irrigation and Mining water demand can be scaled according to available water, and alternate sources, like reuse or groundwater, may be used when surface water is scarce.

7.5.2 Groundwater Supply Drought Response Recommendations

Many users in Region M rely on groundwater as their main source of supply. The aquifers and subsections of aquifers within Region M exhibit a broad range of drought response characteristics, which require specific drought triggers and responses to be developed for each situation.

In general, groundwater wells may be impacted by increased pumping in the area and by decreasing recharge as a result of drought. Insufficient groundwater or groundwater of acceptable quality may result in a shortage.

For general drought preparedness, wells should regularly be monitored for changing water levels and changes in quality. If required, additional temporary treatment may need to be implemented in order to meet drinking water standards. It is important to understand what temporary treatment options may be used in the case of a shortage. Additional wells, and emergency rehabilitation or deepening of existing wells can help to increase supplies in a shortage.

Under **severe conditions**, established when supplies may not be sufficient to meet demands within 60 days or decrease in well productivity or quality, it is recommended that city utility managers request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, and utilize any available emergency interconnects.

Under **critical conditions**, established when demands are expected to exceed supplies within 30 days, it is recommended that city utility managers implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, and utilize emergency interconnects. In the most extreme cases, trucking in water may be the best alternative to meet immediate needs.

7.6 Drought Management WMS

The Water Management Strategies (WMS) that were considered for Region M included conservation strategies that are intended to reduce demand or reduce losses, and the development of new supplies, which is intended to make the region more resilient to drought. Drought Management WMS that were evaluated for all possible WUGs include the following:

- i. **Advanced Municipal Conservation.** This strategy was recommended for all municipal WUGs with conservation goals and rates based on current and projected per-capita water use.

- ii. Irrigation District Conservation. Irrigation District conveyance and operational efficiencies were estimated to range between 60% and 72%. Improvements specific to each district were recommended. The water savings achieved through the selected strategies were shared among all of the users supplied by each district. These strategies may also alleviate some push water concerns.
- iii. Municipal potable reuse. This strategy was considered for all WUGs and recommended for those WUGs with sufficient wastewater effluent flows for cost-effective implementation.
- iv. Municipal non-potable reuse. This strategy was recommended for select entities that had identified a potential user for non-potable effluent, thus reducing demand for potable water.
- v. Mining conservation and reuse were recommended for all mining WUGs.
- vi. Power generation water use can be decreased by close controls of leaks and spills, on-site reuse, and new technology or approaches that reduce demand for water. Contracts for effluent from nearby wastewater treatment plants can provide a reliable source of water that has fewer negative impacts on water availability in the Region. It is recommended that both on-site and off-site effluent be reused to minimize water demands for power generation. Steam-electric conservation and reuse were recommended for steam-electric WUGs.
- vii. Manufacturing water use can be decreased by close controls of leaks and spills, on-site reuse, and new technology or approaches that reduce demand for water. Contracts for effluent from nearby wastewater treatment plants can provide a reliable source of water that has fewer negative impacts on water availability in the Region. It is recommended that both on-site and off-site effluent be reused to minimize water demands for manufacturing.
- viii. Irrigation WMS were recommended as methods to alleviate the impacts of drought on farmers. On-farm conservation may not significantly reduce irrigation demand, but it does allow for continued operations of farmland in drought periods, which is critical to the regional economy.
- ix. Livestock water supplies are from both groundwater and surface water in Region M. In a drought scenario, it is important that windmill pumps which stock ponds and tanks are only used when needed, rather than allowed to run at all times. Agricultural and livestock demands may be significantly increased in severe drought, which can impact groundwater supplies. In addition to careful management of water supplies, there are drought relief programs that may be pursued to assist with livestock demands in a severe drought, including the emergency Haying and Grazing Program.