7

Drought Response Information, Activities, and Recommendations

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Chapter 7: Drought Response Information, Activities, and Recommendations

[31 TAC §357.42]

Droughts are of great importance to the planning and management of water resources in Texas. Drought generally means periods of less than average precipitation over a certain period. Associated definitions include meteorological drought (abnormally dry weather), agricultural drought (adverse impact on crop or range production), and hydrologic drought (below-average water content in aquifers and/or reservoirs). Drought is generally when there is less than 75 percent of normal precipitation. Therefore, droughts, especially the drought of record (DOR), are of great importance for planning and water management.

Although droughts can occur in all climatic zones, they have the greatest potential to become catastrophic in dry or arid regions such as the High Plains. Mild droughts commonly occur over short periods in Texas; however, there is no certain way to predict how long or severe a drought will be while it is occurring. This uncertainty necessitates planning and preparation for worst-case scenarios in drought-prone areas such as the Llano Estacado Region. Planning and preparation includes understanding historical droughts and drought patterns. With growing water demands, planning is even more important to prevent shortages, deterioration of water quality, and lifestyle/financial impacts on water suppliers and users.

7.1 Drought Indicators

Several drought indicators have been developed to assess the effect of a drought through parameters such as severity, duration, and spatial extent. There are numerous ways that the “worst drought” can be defined. Therefore, it is important to consider multiple indices. The Palmer Drought Severity Index (PDSI), historic reservoir storage volumes, surface water modeling, and groundwater aquifer decline are drought indices that can be incorporated into planning efforts and are discussed in more detail below.

One of the best tools in drought preparedness is a thorough understanding of the DOR, or the worst drought to occur for a particular area during the available period of hydrologic data. However, there are many ways that the “worst drought” can be defined (degree of dryness/severity, duration, relative soil moisture content, agricultural impacts, socioeconomic impacts, etc.). Regional water planning focuses on hydrological drought, which is typically the type of drought associated with the largest shortfalls in surface and/or subsurface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale, although it could be different from one area to the next, even within a planning region.

7.1.1 Palmer Drought Severity Index

The PDSI, first published in 1965[1], was one of the first comprehensive efforts using precipitation and temperature for estimating moisture. Using monthly temperature and precipitation data along with the moisture capacity of soils, the PDSI takes into account previous months' water balances to more accurately track drought over time. The National Oceanic and Atmospheric Administration (NOAA) publishes weekly and monthly PDSI maps by climate division for the contiguous United States, going as far back as 1895. This availability makes it a widely used and robust tool to monitor long-term droughts. PDSI values can range from -10 to 10, with negative values indicating dry conditions. The approximate ranges are shown in Table 7-1.

Table 7-1. PDSI Value Ranges

PDSI Value Range	Drought/Moisture Level
Less than -4	Extreme Drought
-4 to -3	Severe Drought
-3 to -2	Moderate Drought
-2 to 2	Mid-Range
2 to 3	Moderately Moist
3 to 4	Very Moist
Greater than 4	Extremely Moist

NOAA[2] divides Texas into ten climate divisions by representing areas with consistent climatological characteristics (Figure 7.1). Figure 7.2 shows the climate divisions within the Llano Estacado Region, which lies primarily within Climate Division 1 (High Plains), but also intersects Division 2 (Low Rolling Plains) to the east. It is necessary to consider these divisions as drought indices are calculated based on characteristics of each climate division.

Figure 7.3 and Figure 7.4 show annual PDSI values[3] for Divisions 1 and 2. During the 1950s and again in the 2010s, the PDSI was less than -4, indicating extreme drought. The PDSI indicates that conditions in 2011 were the most severe and that drought conditions in the 1950s lasted the longest with seven consecutive years with a PDSI value less than zero. The PDSI also indicates that the droughts in the 1950s and the 2010s were extreme for the Llano Estacado Region. However, the PDSI alone does not provide enough information to determine which drought event should be considered the DOR.

1 Palmer, W. C, 1965: Meteorological Drought. Res. Paper No.45, 58pp, Dept. of Commerce, Washington, D.C.

2 NOAA: U.S. Climate Divisions, National Climatic Data Center, www.ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php

3 NOAA: National Environmental Satellite, Data, and Information Service [database], National Climatic Data Center, Retrieved from https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/divisional

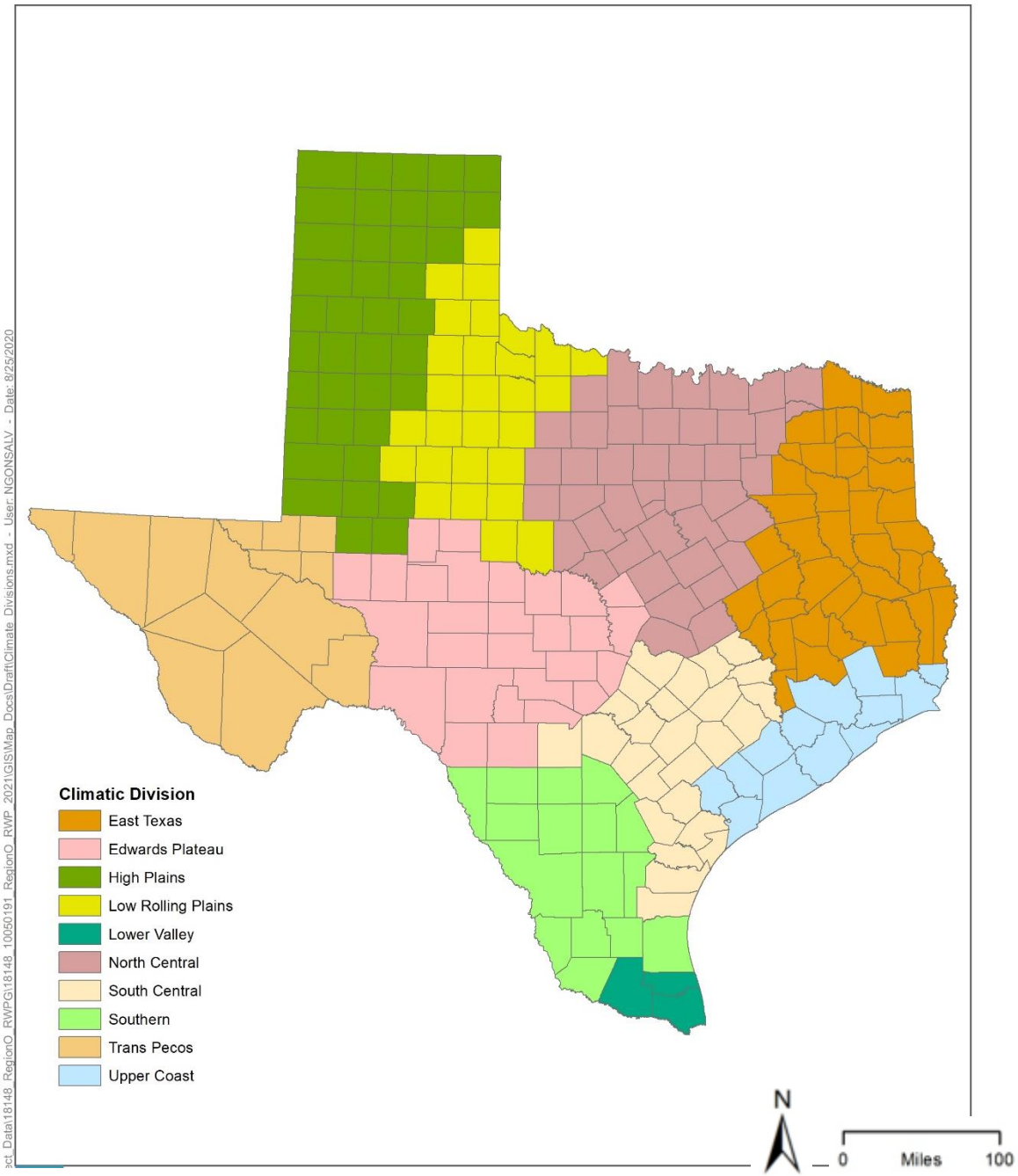

Figure 7.1. NOAA Climate Divisions in Texas

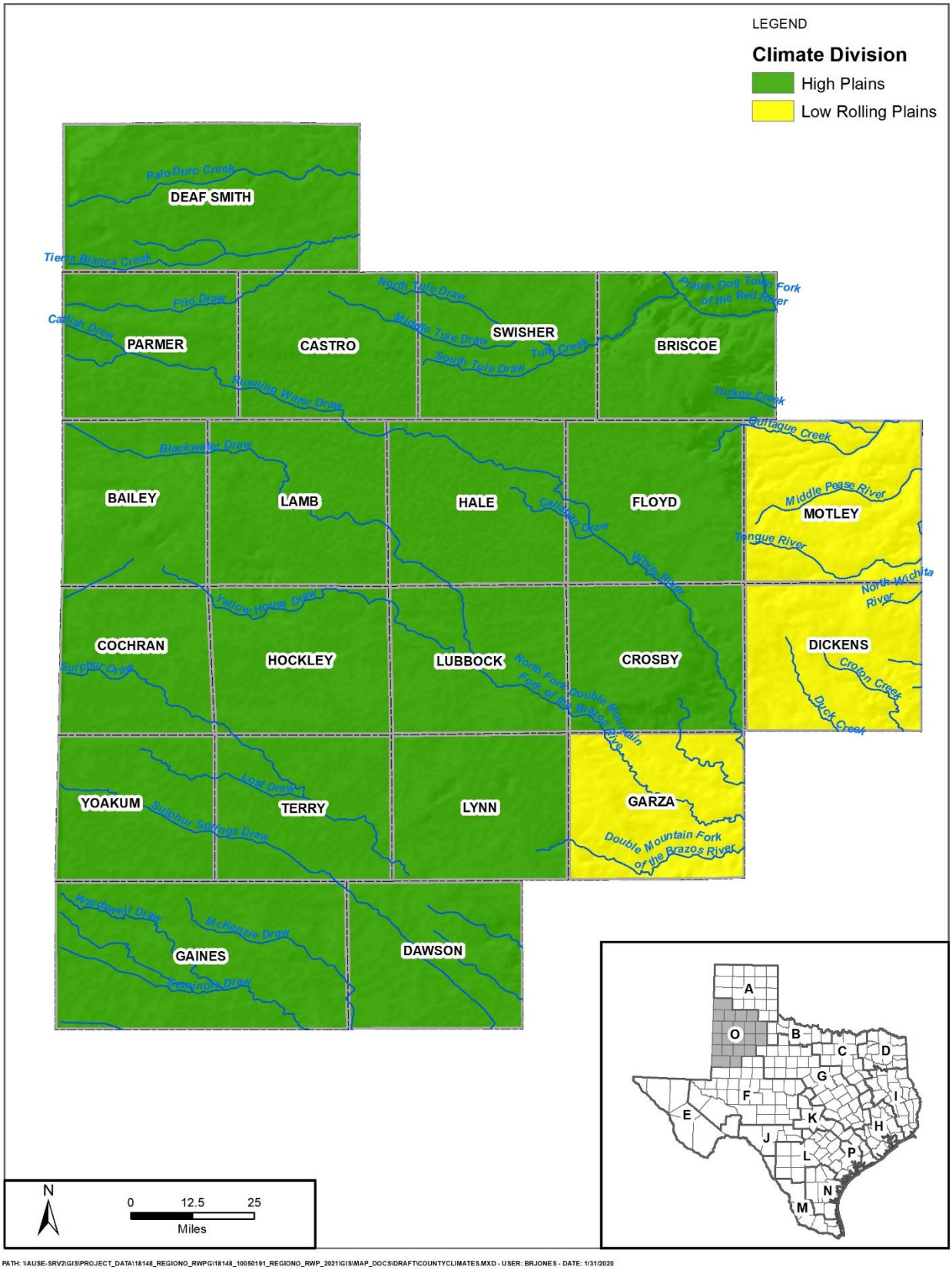

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Figure 7.2. Climate Division within the Llano Estacado Region

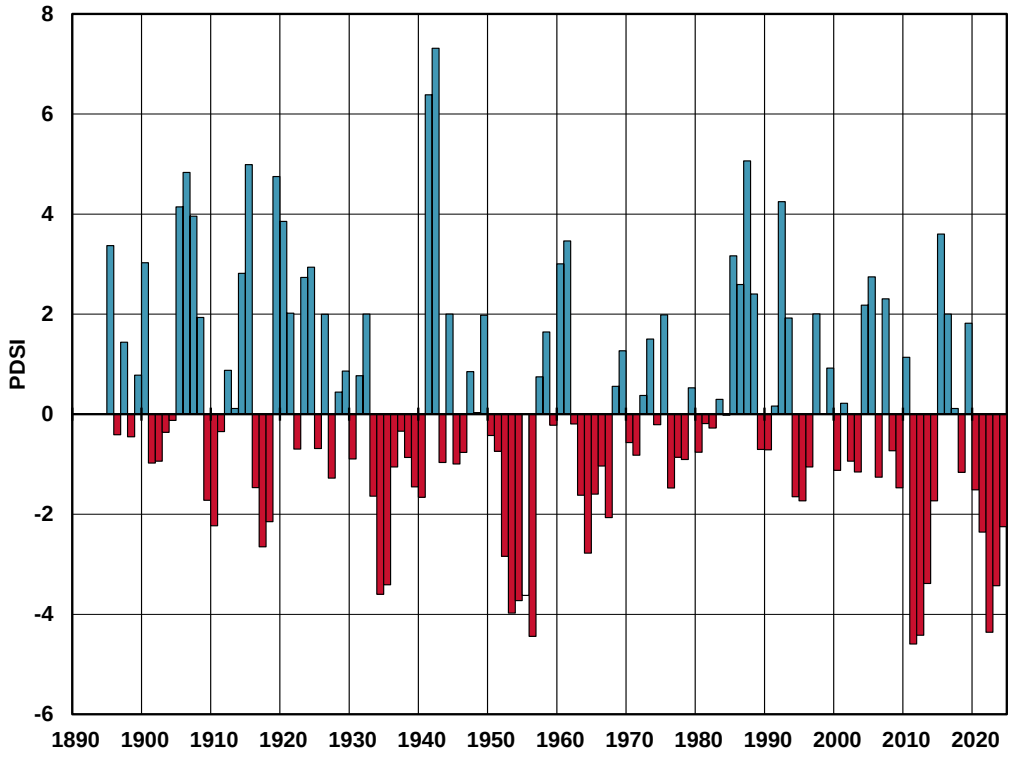

Figure 7.3. Palmer Drought Severity Index: Division 1

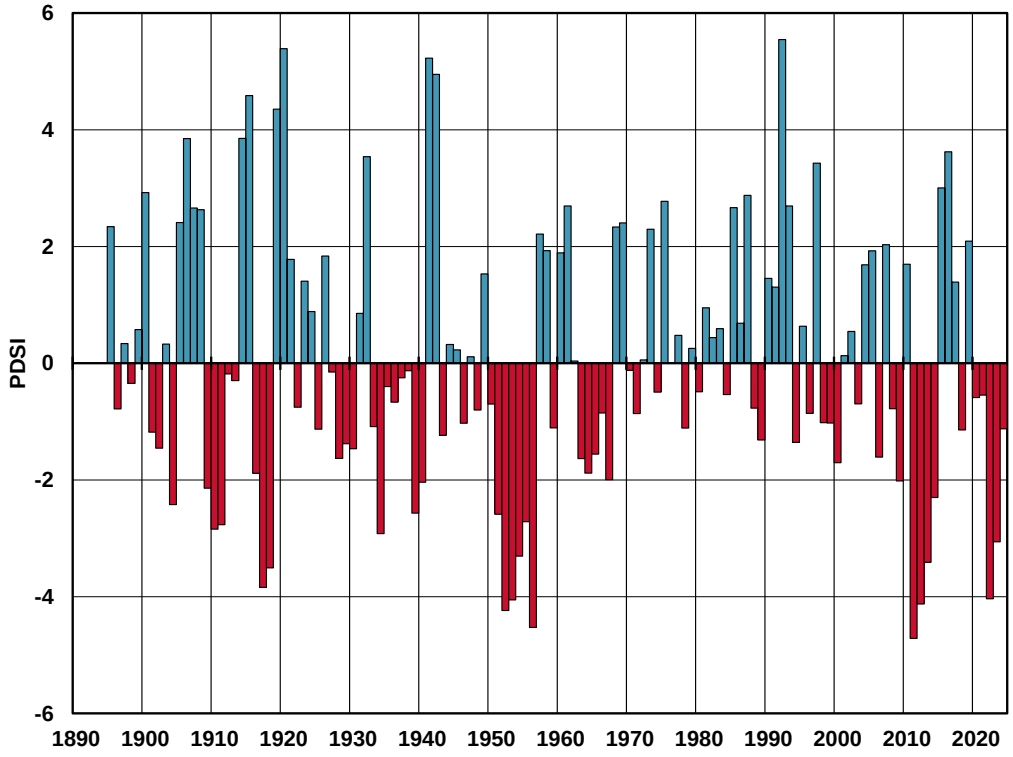

Figure 7.4. Palmer Drought Severity Index: Division 2

7.1.2 Historic Reservoir Storage Volumes

Development of surface water supply sources has been limited in the Llano Estacado Region simply because the area has few significant flowing streams. Four water storage projects are located in or near the Llano Estacado Region. These four water storage projects are Lake Alan Henry (LAH), Lake Meredith, Lake Mackenzie, and White River Lake.

The historical reservoir storage volumes for the four water storage projects are shown in Figure 7.5, Figure 7.6, Figure 7.7, and Figure 7.8. The lakes have rarely exceeded their conservation capacities. The lake storage volumes dropped to low values during the 2010s drought. Although these lakes did not exist in the 1950s, given that the 1950s drought lasted longer than the 2010s drought, reservoir storage volumes for these conditions would have likely dropped to near zero.

The conservation capacities of LAH and White River changed due to the results of volumetric surveys. For LAH, the Brazos River Authority (BRA) states that the area of the lake is 2,884 acres at conservation pool elevation. The results of the Texas Water Development Board (TWDB) 2005 Survey indicate LAH has a volume of 94,808 acre-feet (ac-ft) and encompasses 2,741 acres at conservation pool elevation, 2,220 feet above mean sea level. The TWDB 2005 survey indicates a 5 percent, or 143-acre loss in surface area at the conservation pool elevation[4]. The 2017 TWDB volumetric survey indicates Alan Henry Reservoir has a total reservoir capacity of 96,207 acre-feet and encompasses 2,800 acres at conservation pool elevation (2,220.0 feet above mean sea level, NGVD29).[5] Comparison of the 2005 and 2017 volumetric survey results indicate Alan Henry Reservoir is losing an average of 231 acre-feet of capacity per year.

Upon completion of the White River, the capacity of the lake was calculated to be 38,650 ac-ft. Of this total, 650 ac-ft was dead storage, which resulted in 38,000 ac-ft of conservation storage. Sediment filled the lower 7.6 feet of the lake. The estimated reduction in storage capacity is 13,141 ac-ft, or 29 percent less than that previously conceived on the permit, results in a conservation capacity of 25,509 ac-ft. Due to potential sediment movement and improved data and calculation techniques, the conservation capacity was revised. The resulting effective conservation storage volume for White River Lake is therefore estimated to be 29,880 ac-ft[6].

[4] TWDB. 2006. http://www.twdb.texas.gov/hydro_survey/alanhenry/2005-07/AlanHenry2005_FinalReport.pdf

[5] TWDB. 2017. https://www.twdb.texas.gov/surfacewater/surveys/completed/files/AlanHenry/2017-08/AlanHenry2017_FinalReport.pdf

[6] TWDB. 2003. http://www.twdb.texas.gov/hydro_survey/whiteriver/1992-10/WhiteRiver1993_FinalReport.pdf

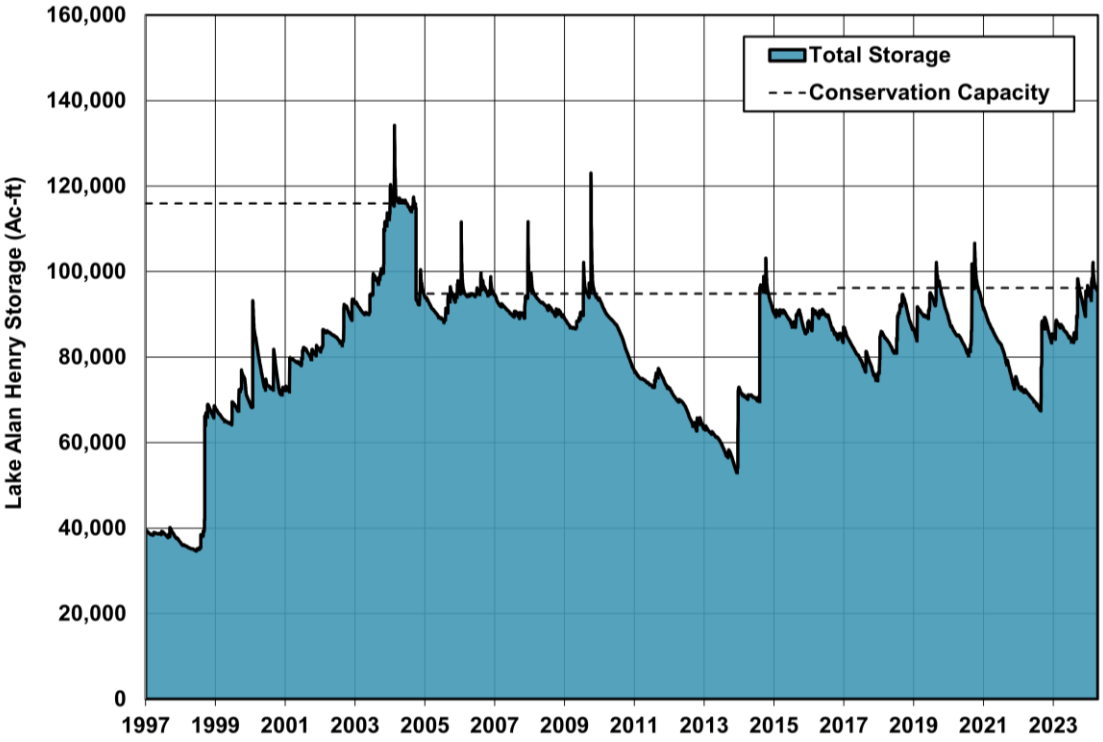

Figure 7.5. Lake Alan Henry Storage

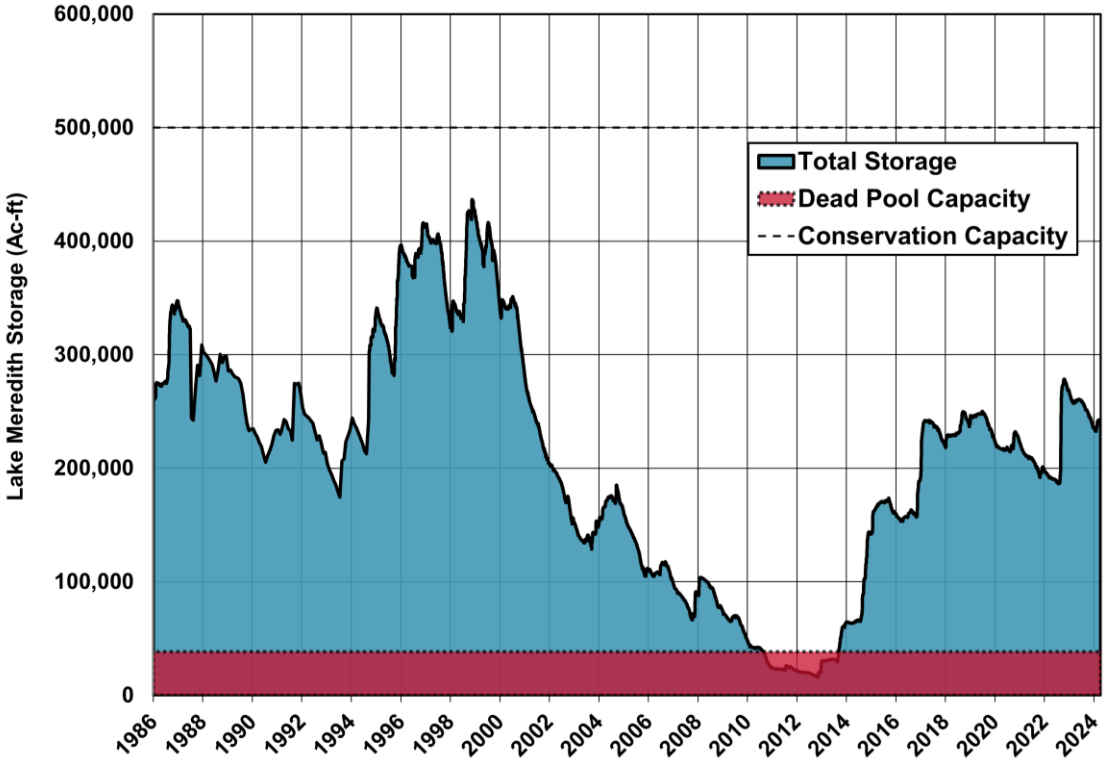

Figure 7.6. Lake Meredith Storage

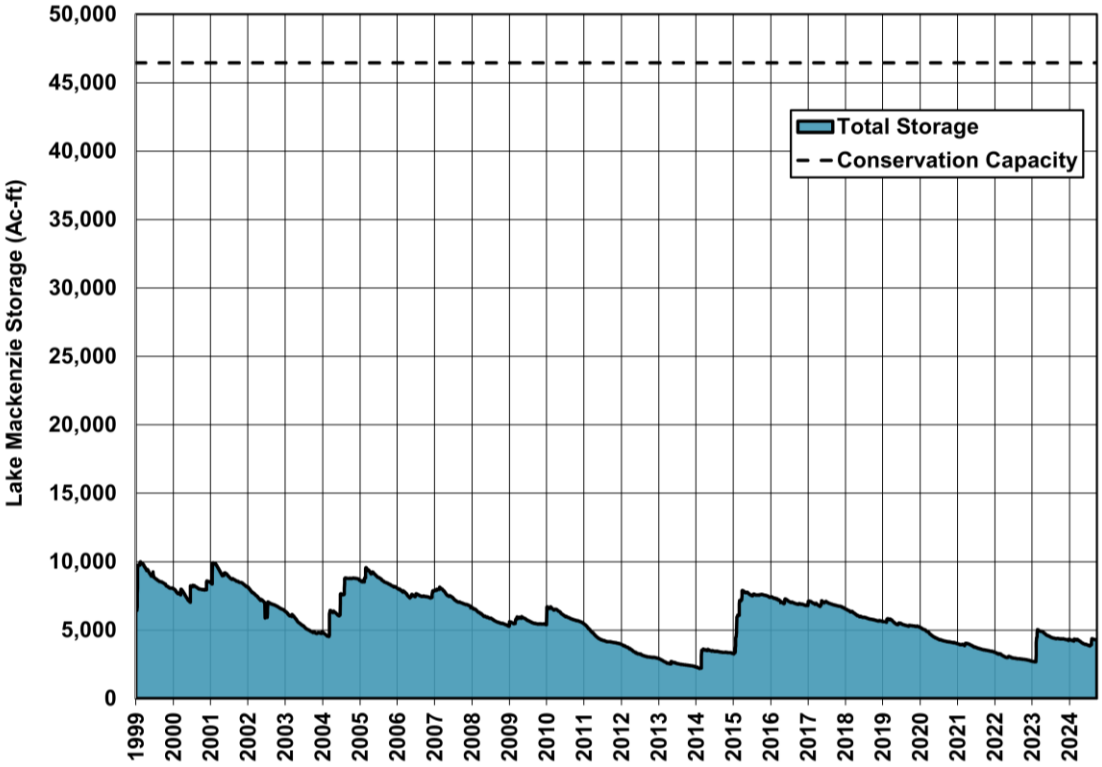

Figure 7.7. Lake Mackenzie Storage

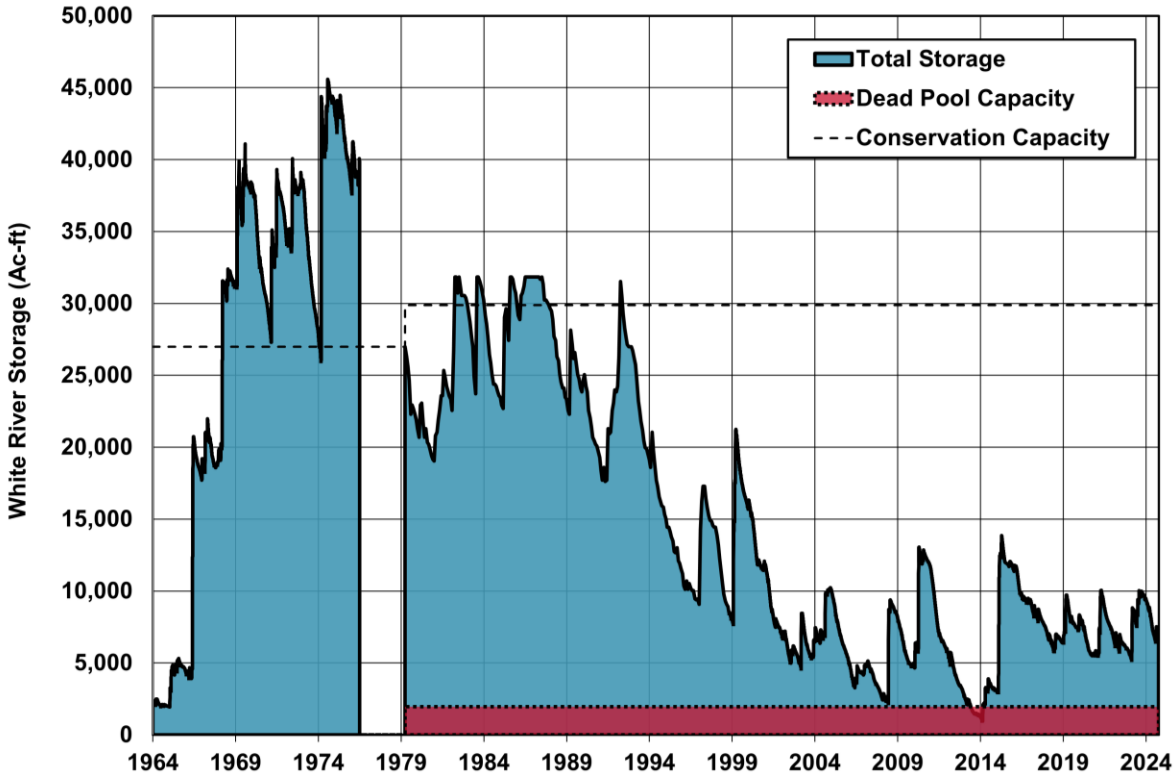

Figure 7.8. White River Lake Storage

7.1.3 Surface Water Modeling

Engineers and planners often use surface water models to demonstrate the effects of historical droughts on water supply. Surface water effects are more readily observed than groundwater effects. Reservoir supplies that were not in place during historic droughts can be assessed using historic hydrology and these modeling tools.

The primary tool used in regional planning in Texas to observe the performance of reservoirs under historic drought conditions is the Texas Commission on Environmental Quality (TCEQ) water availability model (WAM). The WAM is the same tool used to determine the available flow, firm yield, and safe yield of surface water projects in the 2025 LERWP. The Brazos River Basin WAM (Brazos WAM) includes hydrologic information from 1940 to 2018 and supports the use of the 1950s drought for most reservoirs in the Brazos River Basin.

RiverWare modeling software is a related tool developed by the Center for Advanced Decision Support for Water and Environmental Systems used to model the LAH Reservoir and uses hydrology through 2016. The model was used to estimate yield and summarize three periods when drought conditions existed. Table 7-2 shows the firm, 1-year, 18-month, and 2-year safe yields for the 1950s, 1990s and 2010s[7]. This analysis indicates a predicted decline to low yields during these periods.

Table 7-2. Summary of LAH Yields (acre-feet/year)

Yield Basis	1950's (Nov 1942 - Sep 1955)	1990's (Jul 1992 - May 2001)	2010's (Aug 2010 - May 2015)
Firm	22,725	22,210	20,800
1-Year Safe	19,650	18,770	16,125
18-Month Safe	18,325	17,320	14,400
2-Year Safe	17,200	16,100	13,000

7.1.4 Groundwater Aquifer Levels

Groundwater data is another way engineers and planners look at the effects of drought and the corresponding long-term, drought-induced water use on water supply. In the Llano Estacado Region, groundwater makes up a significant portion of the area's water supply. Therefore, it can be useful to analyze drought with respect to the groundwater system to provide a more complete picture of the connection between drought and the Llano Estacado Region's water supply.

In most observation wells, groundwater levels, or heads, fluctuate continuously based on a number of stresses, including precipitation, evaporation, surface water levels, and pumping. As such, a time series of groundwater heads can provide important information on how a particular aquifer will respond to pumping based on drought, or the severity of drought within an aquifer. Five wells with long-term records located within the Llano Estacado Region were selected as representative of the long-term decline in water levels (Figure 7.9).

[7] HDR, Inc., Update of Lake Alan Henry Yield and 5-Year Projections, City of Lubbock Water Supply Support, August 2015.

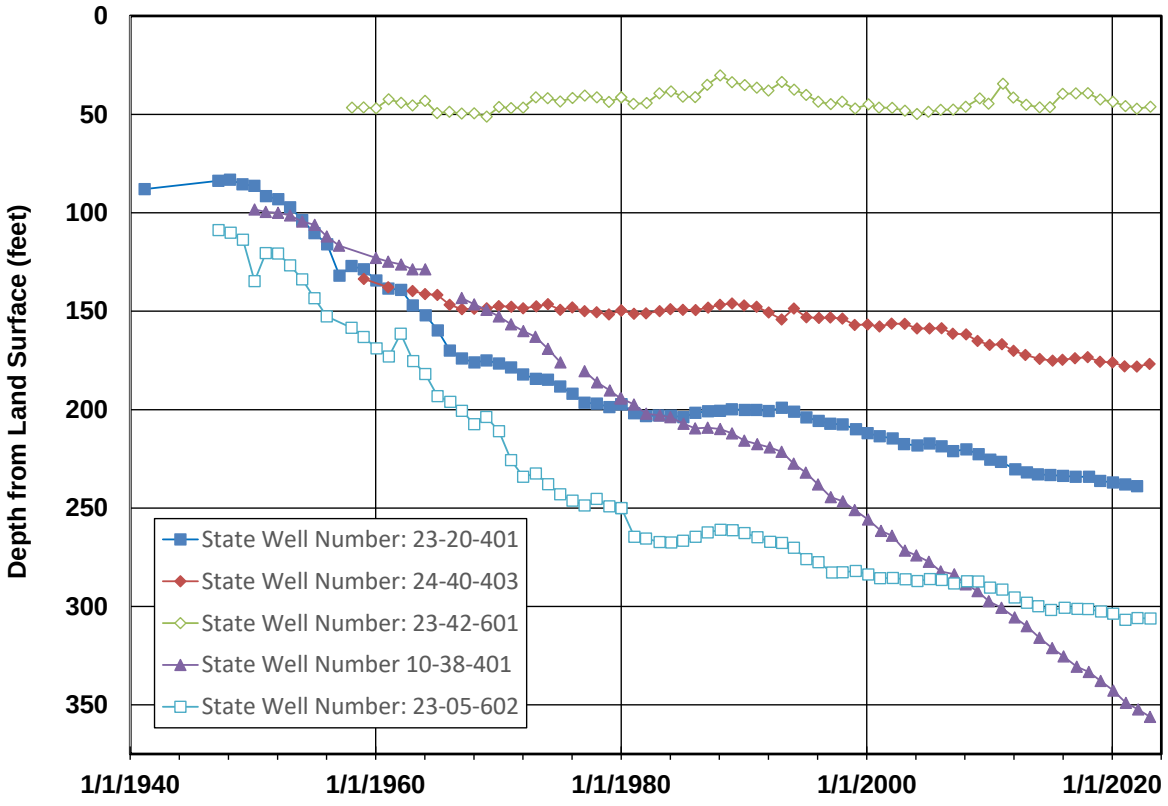

Figure 7.9. Representative Wells with Long-term Records Demonstrating Declining Water Levels

8.1.1 Climate

Most of the planning region is identified as a cold, steppe climate (BSk) under the Köppen climate classification system[8]. This climate is characterized by large variations in the magnitude of ranges in daily temperature extremes, low relative humidity, and irregularly spaced rainfall of moderate amounts. The predominant feature of this climate is dry with mild winters[9]; annual evaporation typically exceeds precipitation in these areas[10]. A summary of climatological conditions for the region is provided in Table 7-3.

[8] Kottek, M.J., Grieser, C., Beck, B., Rubel, F., 2006. World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263.

[9] Larson, T.J., Bomar, G.W. 1983. Climatic atlas of Texas. Texas Water Development Board, LP-192.

[10] Bailey, R.G. 1980. Description of the ecoregions of the United States. U.S. Department of Agriculture, Miscellaneous Publication 1391.

Table 7-3. Historical Climatological Data (1945 to 2024) for the Llano Estacado Region[11] [12]

County	Precipitation			Temperature					Annual Net Lake Surface Evaporation (inches)
	Mean Annual (inches)	Wettest Month	Driest Month	Mean Annual (°F)	Mean Daily Minimum		Mean Daily Maximum		
					Jan (°F)	July (°F)	Jan (°F)	July (°F)	
Bailey	17	Aug	Feb	57	21	63	53	92	46
Briscoe	20	June	Jan	59	24	66	52	92	45
Castro	19	June	Feb	57	21	63	51	91	46
Cochran	17	July	Feb	59	23	64	54	92	47
Crosby	21	May	Jan	60	25	67	53	93	46
Dawson	17	June	Jan	61	26	67	55	94	50
Deaf Smith	18	Aug	Jan	57	21	63	51	92	46
Dickens	21	May	Jan	62	27	69	55	95	47
Floyd	202	June	Jan	59	24	67	52	93	45
Gaines	16	Sept	Dec	61	27	66	56	94	55
Garza	20	May	Jan	63	28	70	55	95	46
Hale	18	June	Feb	59	24	66	52	91	45
Hockley	18	Sept	Feb	59	24	65	54	93	47
Lamb	17	June	Feb	58	22	64	53	92	46
Lubbock	18	May	Dec	61	26	68	54	93	46
Lynn	19	May	Jan	61	26	67	55	93	46
Motley	22	June	Jan	62	28	70	54	95	44
Parmer	18	August	Feb	57	22	63	51	91	46
Swisher	20	June	Jan	58	22	65	51	92	45
Terry	18	May	Dec	60	26	66	54	93	47
Yoakum	16	Sept	Jan	60	25	65	54	93	47

°F = degrees Fahrenheit

In an average year, 70 to 80 percent of the annual precipitation total occurs during the warm season (May through October). A summary of the mean monthly precipitation as a percentage of mean annual precipitation is presented in Table 7-4. Monthly rainfall quantities ordinarily decline markedly in the colder months of the year, when frequent periods of cold, dry air from North American Polar Regions surge southward and cut off the supply of moisture from the Gulf of Mexico.

Table 7-4. Percentage of Mean Annual Precipitation Occurring by Month (1945 to 2024) [13]

County	Percentage of Mean Annual Precipitation											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bailey	3%	3%	4%	5%	13%	15%	14%	16%	13%	9%	4%	3%
Briscoe	3%	3%	5%	7%	15%	17%	10%	12%	11%	8%	4%	3%
Castro	3%	3%	4%	5%	13%	17%	13%	14%	12%	9%	4%	3%
Cochran	3%	3%	4%	5%	12%	13%	15%	15%	13%	9%	4%	3%

[11] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

[12] Texas Water Development Board, 2019. Water Data for Texas: Lake Evaporation and Precipitation. https://waterdatafortexas.org/lake-evaporation-rainfall

[13] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

Table 7-4. Percentage of Mean Annual Precipitation Occurring by Month (1945 to 2024) [13]

County	Percentage of Mean Annual Precipitation											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Crosby	3%	4%	5%	7%	14%	13%	11%	11%	13%	10%	5%	4%
Dawson	3%	4%	5%	6%	13%	14%	11%	10%	16%	10%	5%	4%
Deaf Smith	3%	3%	5%	5%	12%	15%	15%	16%	11%	9%	4%	3%
Dickens	3%	4%	5%	7%	15%	13%	11%	11%	12%	10%	5%	3%
Floyd	3%	3%	5%	7%	15%	16%	11%	11%	13%	9%	4%	3%
Hale	4%	4%	5%	5%	13%	12%	13%	11%	15%	10%	5%	4%
Hockley	3%	4%	4%	7%	14%	13%	11%	11%	13%	10%	5%	4%
Gaines	3%	3%	4%	6%	15%	16%	12%	12%	12%	9%	4%	3%
Garza	3%	3%	4%	5%	13%	14%	13%	13%	14%	9%	4%	4%
Lamb	3%	3%	4%	5%	13%	16%	13%	14%	12%	9%	4%	3%
Lubbock	3%	3%	5%	6%	15%	15%	12%	11%	13%	9%	4%	3%
Lynn	4%	4%	4%	6%	15%	14%	12%	10%	13%	10%	5%	4%
Motley	3%	4%	5%	8%	14%	15%	10%	11%	12%	9%	5%	4%
Parmer	3%	3%	4%	5%	12%	15%	14%	15%	11%	9%	4%	3%
Swisher	3%	3%	5%	6%	14%	17%	12%	13%	10%	9%	4%	3%
Terry	3%	3%	4%	5%	15%	15%	13%	11%	13%	10%	4%	3%
Yoakum	3%	3%	4%	5%	12%	13%	14%	14%	15%	10%	4%	4%

Mean annual precipitation in the region ranges from a low of approximately 16 inches in southwestern Gaines and Yoakum Counties to a high of approximately 22 inches in eastern Motley County. The magnitude of annual precipitation generally increases moving from the west to the east across the region. An illustration of mean annual precipitation is presented in Figure 7.10. Minimum and maximum annual precipitation totals across the region are provided in Figure 7.11 and Figure 7.12, respectively. Precipitation is the only reoccurring/renewable water supply for the Llano Estacado Region. Precipitation meets about 60 percent of urban landscape water and irrigated crop demands and contributes the water available for surface reservoirs, rangeland and dryland crop production, wildlife, and natural recharge to the region's aquifers.

Less than 1 percent of the precipitation escapes from the region in the form of runoff in streams or rivers. The remainder of runoff is collected in approximately 14,000 playa basins located within the Llano Estacado Region[14]. Playas comprise approximately 2 percent of the total land surface within the region. Most playa basins are ephemeral, holding water only during and for a short period after rains, unless augmented by irrigation tailwater. Agricultural activities converted most of the playas into production with some of the playas planted to crops, some left fallow, and some grazed. This conversion also modified approximately 70 percent of the playas to have pits for recovering rainfall runoff for irrigation or creating a water reserve for grazing livestock or wildlife when the bulk of the water collected in the basin from rainfall runoff has soaked into the soil or evaporated. Values for annual net lake surface evaporation range from a high of 54 inches per year for the southern portion of the region to a low of 45 inches per year in the north.

[14] Guthery, F.S., F.C. Bryant, B. Kramer, A. Stoecker, and M. Dvoracek, "Playa Assessment Study", U.S. Water and Power Resources Service, Southwest Region, Amarillo, Texas, 1981.

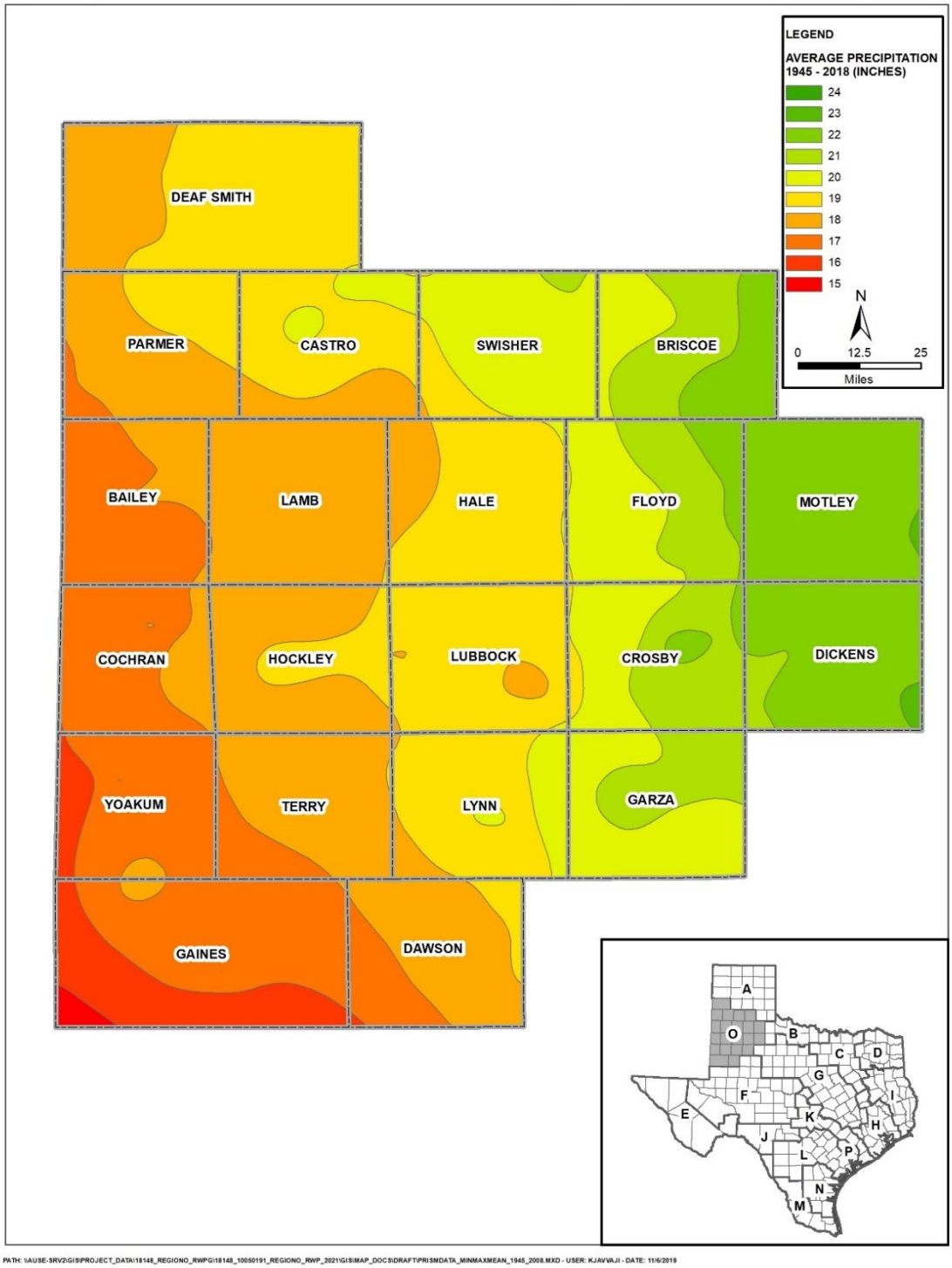

Figure 7.10. Average Annual Precipitation of the Llano Estacado Region 1945-2018[15]

[15] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

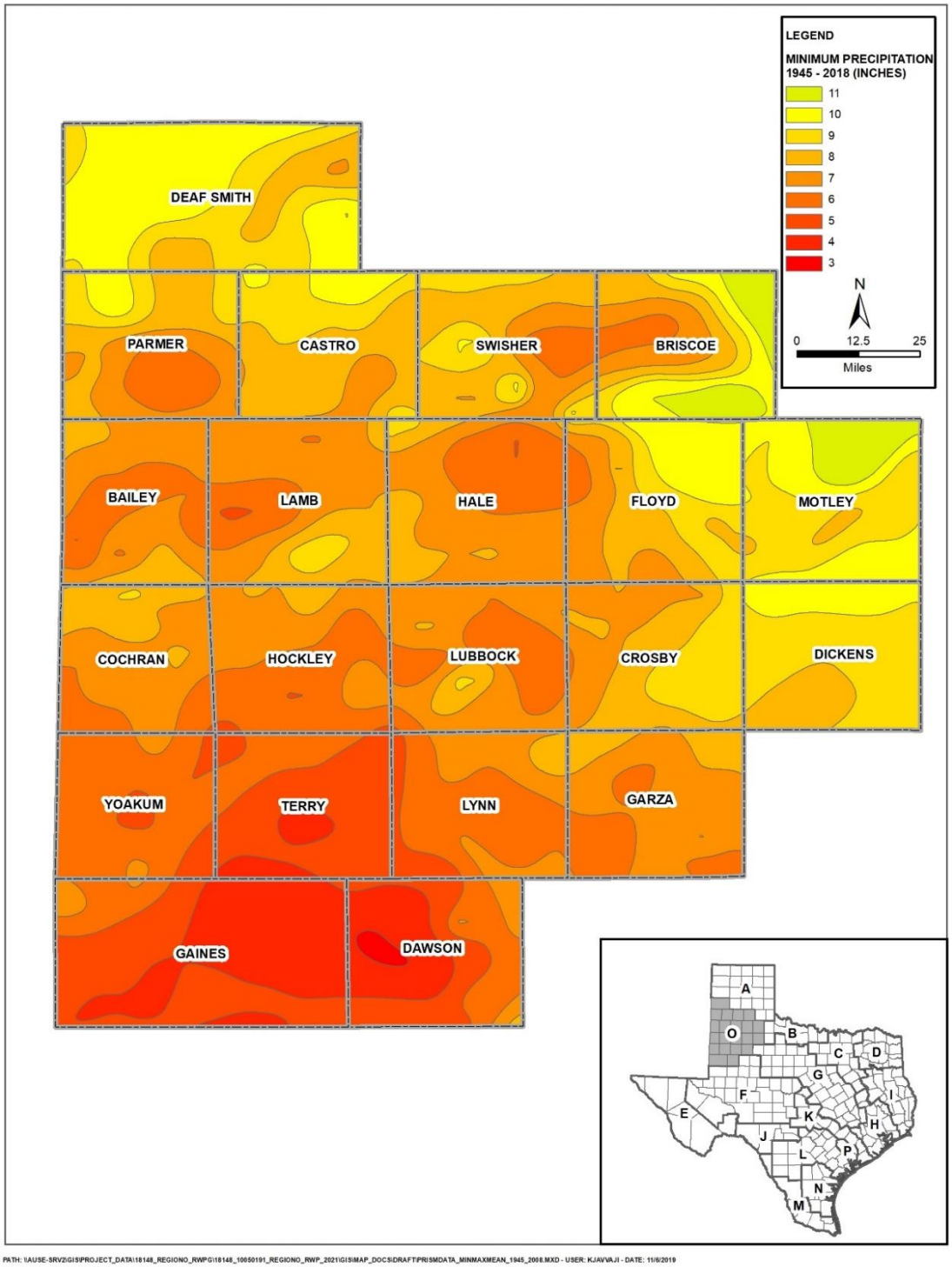

Figure 7.11. Minimum Annual Precipitation of the Llano Estacado Region: 1945-2018 [16]

[16] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

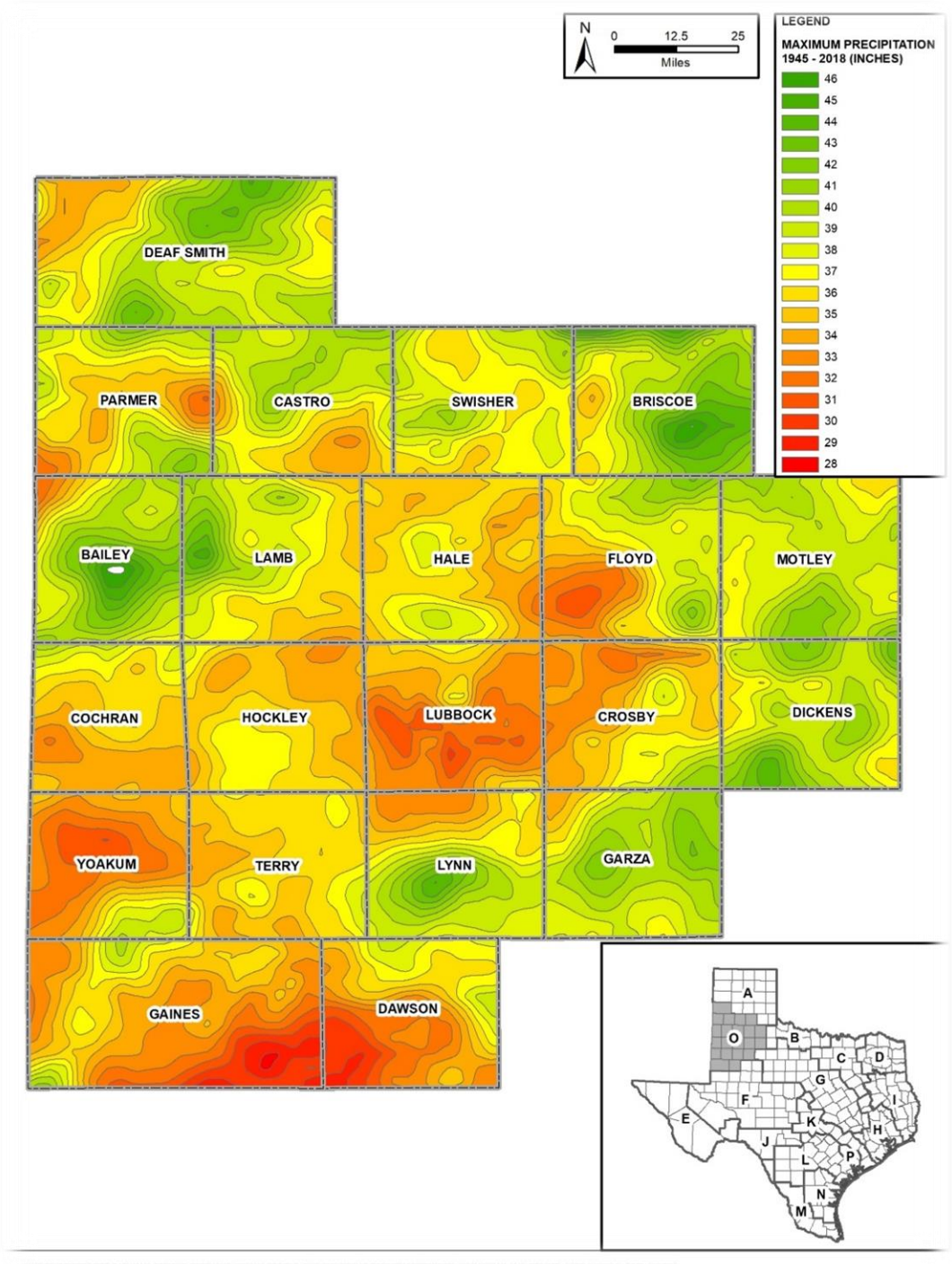

Figure 7.12. Maximum Annual Precipitation of the Llano Estacado Region: 1945-2018 [17]

[17] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

7.2 Droughts of Record in the Llano Estacado Region

7.2.1 Drought of Record

In terms of severity and duration, the devastating drought of the 1950s is considered the DOR for most of Texas. By 1956, 244 of the 254 counties in the state were considered disaster areas. At that time, the 1950s drought included the second, third, and eighth driest years on record (1956, 1954, and 1951, respectively). This drought lasted almost a decade in many places and affected numerous states across the nation. The 1950s drought served as a catalyst for Texas' water supply planning effort and has been used by water resource engineers and managers as a benchmark drought for water supply planning.

7.2.2 Recent Droughts

The Llano Estacado Region has experienced two recent droughts centered around 1996 and 2011 that were significant enough to be used for planning.

Drought indicators do not show the 1990s drought to be an extreme drought, but it was a period of decreased moisture.

The 2010s drought (2010 through 2015) is the most recent drought. In 2011, severely decreased precipitation resulted in substantial declines in streamflow throughout Texas. Record high temperatures also occurred June through August leading to an increase in evaporation rates. The evaporation was so great that by August 4, 2011, state climatologist John Nielson-Gammon declared 2011 to be the worst 1-year drought on record in Texas[18]. The 2011 water year statewide annual precipitation was 11.27 inches, more than 2 inches less than the previous record low of 13.91 inches in 1956. In Lubbock, the total precipitation recorded was 5.86 inches[19].

More recently in 2018, the region faced another period of low rainfall and high temperatures. The ninth warmest year on record for the region was in 2018. Precipitation was intermittent and sparce through the spring and summer in many areas. During 2018, Lubbock recorded 15.27 inches of precipitation (much of it occurring in the fall), which was the 41st driest in the historical record, almost 4 inches below average. Therefore, many entities, including the cities of Lubbock and Wolfforth, enacted mandatory water use restrictions. Some entities, including Lubbock, now have mandatory water use restrictions in place during the summer months regardless of drought conditions. Each entity in the Llano Estacado Planning Region will implement mandatory water use restrictions, as needed, during times of drought to help curtail water use and to extend the supply of water available to them.

[18] Winters, K.E., 2013, A historical perspective on precipitation, drought severity, and streamflow in Texas during 1951-56 and 2011: U.S. Geological Survey Scientific Investigations Report 2013-5113, p. 1 http://pubs.usgs.gov/sir/2013/5113

[19] https://www.weather.gov/lub/events-2011-20111231-summary

7.3 Current Drought Preparations and Response

7.3.1 Current Drought Preparations and Responses

Predicting the timing, severity, and length of a drought is an inexact science; however, it is safe to assume that it is an inevitable component of the Texas climate. For this reason, it is critical to plan for these occurrences with policy outlining adjustments to the use, allocation, and conservation of water in response to drought conditions. Drought and other circumstances that interrupt the reliable supply or water quality of a source often lead to water shortages. During a drought, there generally is a greater demand on the already decreased supply as individuals attempt to maintain landscape vegetation through irrigation because less rainfall is available. This can further exacerbate a water supply shortage situation.

TCEQ requires public wholesale water providers (WWPs), retail public water suppliers serving 3,300 connections or more, and irrigation districts to submit drought contingency plans (DCPs). In accordance with the requirements of Texas Administrative Code (TAC) §288(b), DCPs must be updated every 5 years and adopted by retail public water providers. The TCEQ defines a DCP as "A strategy or combination of strategies for temporary supply and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies."[20] According to a TCEQ handbook[21], the underlying philosophy of drought contingency planning is that

- while often unpreventable, short-term water shortages and other water supply emergencies can be anticipated;
- the potential risks and impacts of drought or other emergency conditions can be considered and evaluated in advance of an actual event; and, most importantly,
- response measures and best management practices (BMPs) can be determined with implementation procedures defined, again in advance, to avoid, minimize, or mitigate the risks and impacts of drought-related shortages and other emergencies.

Model DCPs are available on TCEQ's website; however, it is not possible to create a single DCP that will adequately address local concerns for every entity throughout Texas. The conditions that define a water shortage can be very location specific and depend on the water supply source. For example, some communities rely on the level of LAH, yet others rely on various groundwater aquifer systems that are considered at risk under location-specific conditions. While the approach to planning may be different between entities, DCPs should 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,

[20] http://www.twdb.texas.gov/conservation/training/archives/more-than-a-drop-workshop/doc/5_%20TCEQ%20Rules.pdf

[21] TCEQ. 2005. Handbook for Drought Contingency Planning for Retail Public Water Suppliers, Austin, Texas. April 2005.

- Notification procedures,
- Enforcement procedures,
- Procedures for granting exceptions,
- Public input to the plan,
- Ongoing public education,
- Adoption of plan, and
- Coordination with regional water planning groups.

7.3.2 Overall Assessment of Local Drought Contingency Plans

For water suppliers such as those in the Llano Estacado Region, the primary goal of DCP development is to have a plan that can provide an uninterrupted supply of water in an amount that can satisfy essential human needs. A secondary but also important goal is to minimize negative impacts on quality of life, the economy, and the local environment. In order to meet these goals, action needs to be taken in an expedient, pre-determined procedure, requiring that an approved DCP be in place before drought conditions occur.

In accordance with TAC, most Llano Estacado Region entities have developed DCPs or water conservation plans (WCPs) to be implemented when local shortages occur. The Llano Estacado Region was able to obtain DCPs for multiple water user groups (WUGs) and WWPs. These plans identify multiple triggers for initiation and termination of drought stages, responses to be implemented, and reduction targets based on each stage. The plans also include information regarding public notification procedures and enforcement measures. Some WUGs or WWPs have included a method of granting a variance should the need arise.

7.3.3 Summary of Existing Triggers and Responses

Through timely implementation of drought response measures, it is possible to meet the goals of the DCP by avoiding, minimizing, or mitigating risks and impacts of water shortages and drought. In order to accomplish this, DCPs are built around a collection of drought responses and triggers based on various drought stages. Stages are generally similar for DCPs, but can vary from entity to entity. Stage one will normally represent mild water shortage conditions and the severity of the situation will increase through the stages until emergency water conditions are reached and, in some cases, a water allocation stage is determined.

The Llano Estacado Regional Water Planning Group (LERWPG) compiled stage, trigger, and response information for 17 DCPs/WCPs in the region, including those from WWPs, WUGs, and county-other suppliers. Compliance in most of the DCPs in the region is voluntary under Stage I and mandatory under Stage II and Stage III. Most entities included a Stage IV and a few plans specify a Stage V and/or Stage VI scenario. Target reductions, triggers, and responses are included for most stages. As summary of these in the DCPs/WCPs can be found for Llano Estacado Region entities in Table 7-5.

In accordance with House Bill 807 (HB 807), passed by the 86th Texas Legislature in 2019, and codified in Texas Water Code (TWC) §16.053(e)(3)(E), “RWPGs [regional water planning groups] should identify unnecessary or counterproductive variations in specific drought response strategies, including outdoor watering restrictions, among user groups in the regional water planning area (RWPA) that may confuse the public or otherwise impede drought response efforts,” are to be

identified in the Llano Estacado Region. In the Llano Estacado Region, the prevailing attitude is for conservation because of the constant threat of drought and the relatively low amount of precipitation received in the region. As the largest city in the region, the City of Lubbock sets an example throughout the planning area with its progressive conservation and drought planning.[22] In addition, water users in the region base their drought triggers uniformly on available supply. For example, drought triggers are not set on varying reservoir levels because of the lack of surface water in the region. Through the process of assessing the region's DCPs and existing drought triggers and responses, no unnecessary or counterproductive variations in specific drought response strategies were identified.

Table 7-5. Common Drought Response Measures

Entity Name	DCP/ WCP Date	Stage Number	Triggers									Responses								
			Contamination	Demand/Capacity Based	Failure	Groundwater Level	Production Rate	Reservoir Level	Supply Based	Wholesale Provider	Other	Assessment and Identification	Irrigation Schedule	Mandatory Reduction	Notification of Entities	Prohibited Use	Restrictions	Curtailment	Water Allocation	Other
City of Anton	4/1/2015	1		X					X				X							X
		2		X					X				X			X	X			
		3		X					X				X			X	X			
		4		X					X				X			X	X			
		5	X		X				X				X			X				X
City of Brownfield	4/18/2019	1							X		X		X							X
		2	X		X				X				X			X	X			
		3	X	X					X				X			X	X			
City of Lamesa	3/19/2024	1							X		X		X							X
		2							X		X		X			X	X			
		3	X	X					X		X		X			X	X			
		4							X		X		X			X	X			
		5	X		X				X				X			X				X
City of Levelland	8/5/2024	1		X							X		X				X			
		2		X							X		X			X	X			
		3		X							X		X			X	X			
		4		X							X		X			X	X			
		5	X		X											X	X			
City of Littlefield	8/1/2014	1		X					X		X		X							X
		2							X		X		X			X	X			
		3		X	X				X		X		X			X	X			
		4	X		X				X				X			X	X			
		5		X	X				X		X		X			X				X

[22] https://www.lubbockonline.com/news/20200131/lubbocks-stingy-water-usage-buying-time-on-infrastructure-projects

Table 7-5. Common Drought Response Measures

Entity Name	DCP/ WCP Date	Stage Number	Triggers									Responses								
			Contamination	Demand/Capacity Based	Failure	Groundwater Level	Production Rate	Reservoir Level	Supply Based	Wholesale Provider	Other	Assessment and Identification	Irrigation Schedule	Mandatory Reduction	Notification of Entities	Prohibited Use	Restrictions	Curtailment	Water Allocation	Other
City of Lubbock	4/23/2019	1		X					X				X	X			X			X
		2		X					X				X	X			X			X
		3		X					X				X	X			X			X
		4	X	X	X			X	X				X	X		X	X			X
City of New Deal	5/3/2017										X									X
City of Olton		1									X		X				X			
		2					X						X			X	X			
		3		X			X						X			X	X			
		4		X			X						X			X	X			
		5	X		X								X			X				
		6	X		X						X					X			X	
City of Plainview	4/23/2024	1		X			X				X							X		
		2		X	X		X				X		X				X			
		3		X	X		X				X						X			
		4	X								X		X			X				X
City of Post	8/11/2009	1		X			X				X		X							X
		2		X			X				X		X	X			X			
		3		X			X				X					X	X			
		4	X	X	X		X				X	X			X					X
City of Ropesville	2/13/2019	1					X		X				X							X
		2		X					X				X			X	X			X
		3		X									X				X			
		4		X									X			X	X			
		5	X		X				X				X			X	X			
		6		X					X										X	
City of Seagraves	4/1/2015	1					X						X							X
		2		X			X		X				X			X	X			
		3			X	X	X						X				X			
		4						X					X			X	X			
		5	X		X				X				X			X	X			
City of Seminole	8/1/2019										X									X
City of Shallowater	9/1/2018										X									X

Table 7-5. Common Drought Response Measures

Entity Name	DCP/ WCP Date	Stage Number	Triggers									Responses								
			Contamination	Demand/Capacity Based	Failure	Groundwater Level	Production Rate	Reservoir Level	Supply Based	Wholesale Provider	Other	Assessment and Identification	Irrigation Schedule	Mandatory Reduction	Notification of Entities	Prohibited Use	Restrictions	Curtailment	Water Allocation	Other
City of Silverton	4/1/2014	1									X									X
		2									X						X			
		3									X			X			X			
		4									X									X
City of Tahoka	9/8/2014	1		X		X		X	X				X	X			X			X
		2		X	X	X			X				X	X			X			X
		3		X	X	X			X				X	X			X			X
		4	X	X	X			X	X				X	X		X				X
Mackenzie Municipal Water Authority	3/19/2019										X									X
Red River Authority of Texas	7/1/2019	1		X			X													X
		2		X			X													X
		3		X			X								X			X		
		4		X			X								X			X		
Valley Water Supply Corporation	10/4/2019	1									X									X
		2									X						X			
		3									X						X			
White River Municipal Water District	8/19/2024	1		X			X		X								X			
		2		X			X		X				X		X	X	X			
		3		X			X		X					X		X				
		4	X		X									X						

DCP = drought contingency plan; WCP = water conservation plan

7.4 Existing and Potential Emergency Interconnects

A regional planning goal is to provide a connected supply that meets or exceeds DOR demands for the next 50 years. However, it is also important to plan for emergency supplies in the event of a prolonged drought or an interruption/impairment of supply from an existing source. An interconnection between two collaborating municipal WUGs can serve as an alternative means of providing emergency drinking water in lieu of trucking in supply or other expensive options.

In compliance with TAC, Chapter 357 Regional Water Planning Guidelines, available information on existing major water infrastructure facilities that may be used for interconnections in event of an emergency shortage of water was collected. For the Llano Estacado Region, municipal WUGs and WWPs were sent a survey in July 2024 regarding their water supply and use (Appendix G). The survey was used as the method to collect emergency interconnections information.

As part of the survey, water providers were asked to confirm or update information regarding the existence of emergency interconnections integrated with their system, and the providers of the potential emergency supply. Of the 74 WUGs in Llano Estacado Region, 5 responded to the survey.

In accordance with TWC §16.053(r), the information gathered, such as specific connections, is considered confidential and was submitted to the executive administrator but not included in the regional plan. Some circumstances that would require the use of an emergency interconnect system to be operated could affect an entire body of water or aquifer, such as drought or contamination. It is important to know the source of the emergency interconnect provider's supply for this reason. The source to each provider was determined using the TCEQ Water Watch database and surface water (SW) or groundwater (GW) designation. Information on existing and potential interconnect supply capacity or location was not available from either source.

The DCPs do not include making emergency interconnections as planned responses to the drought trigger stages. Emergency interconnections would be an extraordinary response to extreme drought conditions.

A summary table of the existing and potential emergency interconnects in the Llano Estacado Region and the emergency provider's source of supply is presented in Table 7-6.

Table 7-6. Emergency Interconnects

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
Existing Emergency Connections					
Dickens	Spur (resale of White River Municipal Water District (MWD) water)	White River Reservoir	Ogallala Aquifer		
Littlefield	Lubbock	Mix of Lubbock sources	Lake Alan Henry	Ogallala Aquifer	Purchased from CRMWA in Region A
Mackenzie MWD (supply for Silverton)	Tulia	Dockum Aquifer	Ogallala Aquifer		
Seth Ward Water Supply Corporation (WSC)	Plainview	Ogallala Aquifer			
Potential Emergency Connections					
Abernathy	CRMWA	Purchased from CRMWA in Region A			
Abernathy	Shallowater	Ogallala Aquifer	Mix of Lubbock sources	Purchased from CRMWA in Region A	
Amherst	Lubbock	Ogallala Aquifer			
Amherst	Sudan	Ogallala Aquifer			
Anton	Lubbock	Ogallala Aquifer			
Dimmit	Hereford	Ogallala Aquifer			
Dimmit	Friona	Ogallala Aquifer			
Dimmit	Bovina	Ogallala Aquifer			
Dimmit	Farwell	Ogallala Aquifer			
Dougherty WSC	Floydada	Ogallala Aquifer	Mackenzie Reservoir		
Earth / Springlake / Olton (Connection between systems)		Ogallala Aquifer			
Farwell	Clovis, NM	Ogallala Aquifer	Kings River		
Flomot	Dougherty WSC	Ogallala Aquifer			
Grassland	Post	White River Reservoir	Ogallala Aquifer	Purchased from CRMWA in Region A	
Hale Center	CRMWA	Purchased from CRMWA in Region A			

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
Hale Center	Plainview	Purchased from CRMWA in Region A			
Happy	Tulia	Dockum Aquifer			
Hereford	Canyon	Ogallala Aquifer			
Idalou	Lubbock	Mix of Lubbock sources			
Justiceburg	South Garza Water Supply	Lake Alan Henry			
Justiceburg	Lake Alan Henry Water District	Lake Alan Henry			
Kress	CRMWA	Purchased from CRMWA in Region A			
Kress	Tulia	Mackenzie Reservoir	Dockum Aquifer	Ogallala Aquifer	
Lorenzo	Idalou	Ogallala Aquifer			
Morton / White Face (Connection between systems)		Ogallala Aquifer			
Muleshoe	Lubbock	Ogallala Aquifer			
Nazareth	Hart	Ogallala Aquifer			
Petersburg	Lubbock, Plainview, Floydada	Ogallala Aquifer r			
Plains / Denver City / Seagraves / Seminole (Connection between systems)		Ogallala Aquifer			
Post/White River MWD	Lubbock	Lake Alan Henry			
Post/White River MWD	Southland ISD	Ogallala Aquifer			
Quitaque	Silverton, Turkey, or Floydada	Ogallala Aquifer			
Roaring Springs	Matador	Other Aquifer			
Ropesville	Meadow	Purchased from CRMWA in Region A			
Ropesville	Wolfforth	Ogallala Aquifer			
Shallowater	Lubbock	Mix of Lubbock sources			
Slaton	Southland ISD	Ogallala Aquifer			
Sudan	Lubbock	Ogallala Aquifer			
Sundown	White Face	Ogallala Aquifer			
Tulia/Mackenzie MWA	CRMWA	Purchased from CRMWA in Region A			
Wellman	Brownfield	Ogallala Aquifer	Purchased from CRMWA in Region A		

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
White Face	Levelland	Purchased from CRMWA in Region A			
Wilson	Slaton	Purchased from CRMWA in Region A			
Wilson	Tahoka	Purchased from CRMWA in Region A			
Wolfforth	Lubbock	Mix of Lubbock sources			

7.5 Emergency Response to Local Drought Conditions or Loss of Municipal Supply

The regional and state water plans aim to prepare entities for severe drought scenarios based on the DOR. However, entities may find themselves in a local drought or facing a loss of municipal supply. While rare, it is important to have a backup plan in case of infrastructure failure or water supply contamination. This is especially important for smaller entities that rely on a sole source of supply. While many entities and WWPs have DCPs, it is less common for small municipalities to have these emergency plans.

A WUG relying on groundwater is considered sole source if its entire supply comes from the same aquifer regardless of varying groundwater districts or combination of contractual and local development supplies. A WUG relying on surface water is considered sole source if their yield comes from one river intake or one reservoir, regardless of the number of contracts in place. A WUG with a supply contract was not considered sole-source due to system operations. WUGs with both groundwater and surface water supplies were not included, with the exception of county-other entities.

A broad range of emergency situations could result in a loss of reliable municipal supply, and it is not possible to plan one solution to meet any possible emergency. Accordingly, a range of possible responses were selected for each entity based on source type and location. A WUG using groundwater was analyzed for potential additional fresh water and brackish water wells, based on the existence of appropriate aquifers in the area. Modeled available groundwater (MAG) availability was not considered because the wells are assumed temporary over the course of an emergency.

Table 7-7 presents temporary emergency responses that may or may not require permanent infrastructure. For municipal WUGs, a nearby entity that could provide supply in the case of an isolated incident was identified. Existing interconnects for municipal WUGs including the 21 county-other WUGs are included in the analysis. The addition of a local groundwater well and trucking in water are considered as an emergency supply option for all municipal WUGs under severe circumstances. Entities providing municipal supplies to WUGs were assumed to have 180 days or less of municipal supply.

Table 7-7. Emergency Response to Local Drought Conditions or Loss of Municipal Supply for WUGs in the Llano Estacado Region

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2030 Population	2030 Demand (Ac-ft/yr)	Release From Upstream Reservoir	Curtailment of Upstream/Downstream Water Rights	Local Groundwater Well	Brackish Groundwater Desalination	Trucked-in Water	Supply from Nearby Entity	Existing Emergency Interconnect	Potential Entity Providing Supply	Other Local Entities Required to Participate/Coordinate	Emergency Agreements/Arrangements Already in Place	Type of Infrastructure Required
ABERNATHY	HALE	3,134	728			X		X	X		CRMWA, SHALLOWATER			Well, Pipeline, Transportation
AMHERST	LAMB	653	81			X		X	X		LUBBOCK, SUDAN			Well, Pipeline, Transportation
ANTON	HOCKLEY	820	103			X		X	X		LUBBOCK			Well, Pipeline, Transportation
BOVINA	PARMER	1,466	25			X		X	X		FRIONA			Well, Pipeline, Transportation
BROWNFIELD	TERRY	8,861	1,383			X		X	X		SEAGRAVES			Well, Pipeline, Transportation
COUNTY-OTHER, BAILEY	BAILEY	1,900	227			X		X	X		MULESHOE			Well, Pipeline, Transportation
COUNTY-OTHER, BRISCOE	BRISCOE	450	141			X		X	X		SILVERTON			Well, Pipeline, Transportation
COUNTY-OTHER, CASTRO	CASTRO	2,456	348			X		X	X		DIMMITT			Well, Pipeline, Transportation
COUNTY-OTHER, COCHRAN	COCHRAN	630	233			X		X	X		MORTON			Well, Pipeline, Transportation
COUNTY-OTHER, CROSBY	CROSBY	928	106			X		X	X		RALLS			Well, Pipeline, Transportation
COUNTY-OTHER, DAWSON	DAWSON	4,527	542			X		X	X		LAMESA			Well, Pipeline, Transportation
COUNTY-OTHER, DEAF SMITH	DEAF SMITH	4,203	478			X		X	X		HEREFORD			Well, Pipeline, Transportation
COUNTY-OTHER, DICKENS	DICKENS	842	110			X		X	X	X	SPUR (RESALE OF WHITE RIVER MWD WATER)			Well, Pipeline, Transportation
COUNTY-OTHER, FLOYD	FLOYD	1,222	141			X		X	X		FLOYDADA			Well, Pipeline, Transportation
COUNTY-OTHER, GAINES	GAINES	16,148	1,833			X		X	X		SEMINOLE			Well, Pipeline, Transportation
COUNTY-OTHER, GARZA	GARZA	1,117	136			X		X	X		POST			Well, Pipeline, Transportation
COUNTY-OTHER, HALE	HALE	3,973	496			X		X	X		PLAINVIEW			Well, Pipeline, Transportation
COUNTY-OTHER, HOCKLEY	HOCKLEY	7,339	866			X		X	X		LEVELLAND			Well, Pipeline, Transportation
COUNTY-OTHER, LAMB	LAMB	3,006	422			X		X	X		LITTLEFIELD			Well, Pipeline, Transportation
COUNTY-OTHER, LUBBOCK	LUBBOCK	31,664	3,988			X		X	X		LUBBOCK			Well, Pipeline, Transportation
COUNTY-OTHER, LYNN	LYNN	2,661	297			X		X	X		TAHOKA			Well, Pipeline, Transportation
COUNTY-OTHER, MOTLEY	MOTLEY	506	88			X		X	X		MATADOR			Well, Pipeline, Transportation
COUNTY-OTHER, PARMER	PARMER	2,536	484			X		X	X		FRIONA			Well, Pipeline, Transportation
COUNTY-OTHER, SWISHER	SWISHER	2,420	307			X		X	X		TULIA			Well, Pipeline, Transportation
COUNTY-OTHER, TERRY	TERRY	3,047	363			X		X	X		BROWNFIELD			Well, Pipeline, Transportation
COUNTY-OTHER, YOAKUM	YOAKUM	1,531	180			X		X	X		PLAINS			Well, Pipeline, Transportation
CROSBYTON	CROSBY	1,427	218			X		X	X		RALLS			Well, Pipeline, Transportation
DENVER CITY	YOAKUM	5,034	1,390			X		X	X		PLAINS, SEAGRAVES, SEMINOLE			Well, Pipeline, Transportation
DIMMITT	CASTRO	3,737	831			X		X	X		HEREFORD, FRIONA, BOVINA, FARWELL			Well, Pipeline, Transportation
EARTH	LAMB	842	143			X		X	X		SPRINGLAKE, OLTON			Well, Pipeline, Transportation
FARWELL	PARMER	1,546	397			X		X	X		CLOVIS, NM			Well, Pipeline, Transportation
FLOYDADA	FLOYD	2,419	418			X		X	X		LUBBOCK			Well, Pipeline, Transportation
FRIONA	PARMER	4,261	752			X		X	X		BOVINA			Well, Pipeline, Transportation

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2030 Population	2030 Demand (Ac-ft/yr)	Release From Upstream Reservoir	Curtailment of Upstream/Downstream Water Rights	Local Groundwater Well	Brackish Groundwater Desalination	Trucked-in Water	Supply from Nearby Entity	Existing Emergency Interconnect	Potential Entity Providing Supply	Other Local Entities Required to Participate/Coordinate	Emergency Agreements/Arrangements Already in Place	Type of Infrastructure Required
HALE CENTER	HALE	1,876	226			X		X	X		CRMWA, PLAINVIEW			Well, Pipeline, Transportation
HAPPY	SWISHER	488	72			X		X	X		TULIA			Well, Pipeline, Transportation
HART MUNICIPAL WATER SYSTEM	CASTRO	746	106			X		X	X		DIMMITT			Well, Pipeline, Transportation
HEREFORD	DEAF SMITH	15,164	3,352			X		X	X		CANYON			Well, Pipeline, Transportation
IDALOU	LUBBOCK	2,130	373			X		X	X		LUBBOCK			Well, Pipeline, Transportation
LAMESA	DAWSON	7,721	1,739			X		X	X		O'DONNELL			Well, Pipeline, Transportation
LEVELLAND	HOCKLEY	12,404	1,990			X		X	X		WHITE FACE			Well, Pipeline, Transportation
LITTLEFIELD	LAMB	5,558	805			X		X	X	X	LUBBOCK		X	Well, Pipeline, Transportation
LOCKNEY	FLOYD	1,402	186			X		X	X		FLOYDADA			Well, Pipeline, Transportation
LORENZO	CROSBY	886	159			X		X	X		IDALOU			Well, Pipeline, Transportation
LUBBOCK	LUBBOCK	300,165	52,502			X		X						Well, Transportation
MATADOR	MOTLEY	471	162			X		X	X		DICKENS			Well, Pipeline, Transportation
MORTON PWS	COCHRAN	1,470	317			X		X	X		LUBBOCK			Pipeline, Transportation
MULESHOE	BAILEY	5,096	1,013			X		X	X		LUBBOCK			Well, Pipeline, Transportation
NAZARETH	CASTRO	259	98			X		X	X		HART			Well, Pipeline, Transportation
NEW DEAL	LUBBOCK	602	76			X		X	X		LUBBOCK, PLAINVIEW, FLOYDADA			Well, Pipeline, Transportation
ODONNELL	DAWSON	665	89			X		X	X		LAMESA			Well, Pipeline, Transportation
OLTON	LAMB	1,904	387			X		X	X		PLAINVIEW			Well, Pipeline, Transportation
PETERSBURG MUNICIPAL WATER SYSTEM	HALE	926	234			X		X	X		LUBBOCK			Well, Pipeline, Transportation
PLAINS	YOAKUM	1,341	340			X		X	X		DENVER CITY, SEAGRAVES, SEMINOLE			Well, Pipeline, Transportation
PLAINVIEW	HALE	22,403	4,075			X		X	X		LUBBOCK			Well, Pipeline, Transportation
POST	GARZA	4,543	576			X		X	X		LUBBOCK			Well, Pipeline, Transportation
QUITAQUE	BRISCOE	302	75			X		X	X		SILVERTON, TURKEY, FLOYDADA			Well, Pipeline, Transportation
RALLS	CROSBY	1,521	222			X		X	X		CROSBYTOWN			Well, Pipeline, Transportation
RANSOM CANYON	LUBBOCK	1,048	296			X		X	X		LUBBOCK			Well, Pipeline, Transportation
RED RIVER AUTHORITY OF TEXAS	DICKENS	13	3			X		X	X		SPUR			Well, Pipeline, Transportation
SEAGRAVES	GAINES	1,849	297			X		X	X		PLAINS, DENVER CITY, SEMINOLE			Well, Pipeline, Transportation
SEMINOLE	GAINES	7,157	2,336			X		X	X		PLAINS, DENVER CITY, SEAGRAVES			Well, Pipeline, Transportation
SHALLOWATER	LUBBOCK	3,294	482			X		X	X		LUBBOCK			Well, Pipeline, Transportation
SILVERTON	BRISCOE	549	91			X		X	X	X	TULIA		X	Well, Pipeline, Transportation
SLATON	LUBBOCK	5,665	661			X		X	X		SOUTHLAND ISD			Well, Pipeline, Transportation
SPUR	DICKENS	745	125			X		X	X		DICKENS			Well, Pipeline, Transportation
SUDAN	LAMB	883	208			X		X	X		LUBBOCK			Well, Pipeline, Transportation
SUNDOWN	HOCKLEY	1,195	319			X		X	X		WHITE FACE			Well, Pipeline, Transportation

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2030 Population	2030 Demand (Ac-ft/yr)	Release From Upstream Reservoir	Curtailment of Upstream/Downstream Water Rights	Local Groundwater Well	Brackish Groundwater Desalination	Trucked-in Water	Supply from Nearby Entity	Existing Emergency Interconnect	Potential Entity Providing Supply	Other Local Entities Required to Participate/Coordinate	Emergency Agreements/Arrangements Already in Place	Type of Infrastructure Required
TAHOKA PUBLIC WATER SYSTEM	LYNN	2,268	371			X		X	X		LUBBOCK			Well, Pipeline, Transportation
TULIA	SWISHER	3,779	653			X		X	X		CRMWA			Well, Pipeline, Transportation
WHITEFACE	COCHRAN	284	66			X		X	X		LEVELLAND, MORTON			Well, Pipeline, Transportation
WOLFFORTH	LUBBOCK	16,487	2,692			X		X	X		LUBBOCK			Well, Pipeline, Transportation

7.6 Region-Specific Drought Response Recommendations and Model Drought Contingency Plans

The LERWPG acknowledges that DCPs are a useful drought management tool for entities with both surface and groundwater sources and recommends that entitles consider having a current DCP in preparation for drought conditions. The region also recommends that, in accordance with TCEQ guidelines, entities update their DCPs every 5 years as triggers can change as wholesale and retail water providers reassess their contracts and supplies. The LERWPG obtained 17 DCP or WCP documents from across the region.

7.6.1 Drought Response Recommendations for Surface Water

Surface water accounts for a minority of projected 2080 municipal supplies in the Llano Estacado Region (see Chapter 3). With a variety of local supply sources, it is difficult to create a set of triggers and responses that fit the needs of each WUG in the regional planning area. The LERWPG recognizes that supplies are understood best by the water system operators and suggests that WUGs without DCPs look to the DCPs of their water providers as examples, if available.

For entities without DCPs, which supply themselves with local surface water, the LERWPG suggests reviewing the drought responses and recommendations used by similar entities in the region. An example of triggers and responses from the DCPs in the region is presented below (Table 7-8). These were selected as common and representative examples. The triggers depend on parameters such as treatment plant use, storage levels, reservoir elevations, and system failures. The responses include categories ranging from home irrigation limits to commercial and industrial use reductions.

7.6.2 Drought Response Recommendations for Groundwater

Groundwater accounts for most projected 2080 municipal supplies (see Chapter 3). With such a variety of supply sources, it is difficult to create a set of triggers and responses that fit the needs of each WUG in the regional planning area. The LERWPG recognizes that supplies are understood best by the operators and suggests that WUGs without DCPs look to the DCPs of their water providers and groundwater conservation districts as examples, if available.

For entities without DCPs supplying themselves with local groundwater, the LERWPG suggests reviewing the drought responses and recommendations used by similar entities in the region. An example of triggers and responses from the DCPs in the region is presented below (Table 7-8). These were selected as common and representative examples. The DCP includes five water stages ranging from “Mild” to “Water Emergency.” The triggers depend on parameters such as season, ground storage levels, contamination, and system failures. The responses include categories ranging from residential irrigation limits to commercial and industrial use reductions.

Table 7-8. Common Llano Estacado Region Drought Contingencies

Drought Stage	Trigger	Actions
Stage I – MILD	Water use exceeds 80% of available capacity	• City reduces water main flushing. • Voluntary limit on irrigation to 2 days a week at designated times. • Customers are requested to minimize or discontinue non-essential water use.
Stage II – MODERATE	Water use exceeds 90% of available capacity	• Mandatory limit on irrigation to 2 days a week at designated times or by handheld hose or 5 gallon bucket. • Vehicle washing allowed only with handheld bucket or hose. • Filling of pools or Jacuzzis limited to watering days/times. • Non-circulating ponds or fountains are prohibited unless supporting aquatic life. • Use of water from fire hydrants shall be limited to firefighting activities or other activities necessary to maintain public health, safety, and welfare. • All restaurants are prohibited from serving water unless requested. • Non-essential uses are prohibited.
Stage III – SEVERE	Water use exceeds 100% of available capacity	• All actions listed in Stage II. • Irrigation limited to handheld hose or less than 5 gallons of faucet water is used during designated watering days and times. • The use of water for construction from designated hydrants under special permit is discontinued.
Stage IV – CRITICAL	Water use exceeds 105% of available capacity	• All actions listed in Stages II and III. • Only washing of mobile equipment in the critical interest of the public health or safety is allowed. Commercial car washes can be used during designated hours. • Filling of swimming pools or fountains is prohibited. • No applications for new, additional or expanded water service infrastructure shall be approved.
Stage V – EMERGENCY	Water shortage due to infrastructure break, contamination, and/or system outage	• All actions described in previous stages. • Irrigation of landscaped areas is absolutely prohibited. • Use of water to wash any vehicle is absolutely prohibited.

7.6.3 Example Drought Contingency Plans

TCEQ has prepared example DCPs for wholesale and retail water suppliers. The examples provide guidance and suggestions with regard to preparing DCPs. The TCEQ example DCPs may be available on TCEQ's website or otherwise available by contacting one of their offices. Appendix H contains model DCPs for cities with populations smaller than 15,000 and larger than 15,000.

7.7 Drought Management Water Management Strategies

The regional water plan is developed to meet projected water demands during a drought of severity equivalent to the DOR. The LERWPG sees the purpose of the planning as ensuring that sufficient supplies are available to meet future water demands. Therefore, drought management recommendations have not been made by the LERWPG as a WMS for specific WUG needs. Reducing water demands during a drought as a defined WMS does not mean that sufficient supplies will be available to meet the projected water demands, but simply eliminates the demands. While the LERWPG encourages entities in the region to promote demand management during a drought, it should not be identified as a "new source" of supply. Drought management does not make more

efficient use of existing supplies, as does conservation, but instead proposes that water will not be available when the water is needed most. Drought management prioritizes which future water demands are not met under drought conditions.

While drought management WMSs are not supported by the LERWPG, DCPs are encouraged for all entities and the region supports the implementation of the drought responses outlined in these DCPs when corresponding triggers occur. While the relief provided from these DCP responses can prolong supply and reduce impacts to communities, they are not considered to be reliable for all entities under all potential droughts.

7.8 Other Drought Recommendations

7.8.1 Texas Drought Preparedness Council and Drought Preparedness Plan

In accordance with TWDB rules, all relevant recommendations from the Drought Preparedness Council were considered in this chapter. The Texas Drought Preparedness Council is composed of representatives from multiple state agencies and plays an important role in monitoring drought conditions, advising the governor and other groups on significant drought conditions, and facilitating coordination among local, state, and federal agencies in drought response planning. The council meets regularly to discuss drought indicators and conditions across the state and releases situation reports summarizing their findings.

Additionally, the council has developed the *State Drought Preparedness Plan*, which sets forth a framework for approaching drought in an integrated manner in order to minimize impacts to people and resources. The Llano Estacado Region supports the ongoing efforts of the Texas Drought Preparedness Council and recommends that water providers and other interested parties regularly review the situation reports as part of their drought monitoring procedures. The council provided two recommendations to all RWPGs, which are addressed in this chapter.

- Follow the outline template for Chapter 7 provided to the regions by the TWDB in April of 2019, making an effort to fully address the assessment of current drought preparations and planned responses, as well as planned responses to local drought conditions or loss of municipal supply.
- Develop region-specific model DCPs for all water use categories in the region that account for more than 10 percent of water demands in any decade over the 50-year planning horizon.

To meet these recommendations, this chapter corresponds with the sections of the outline template. The Llano Estacado Region has also developed a model DCP for water use categories that exceed 10 percent of the demands. For the Llano Estacado Region, these use categories include irrigation only.

The Llano Estacado Region does not recommend any drought management strategies as a long-term supply solution. Instead, it reserves these types of strategies for unanticipated emergency situations only.

7.8.2 Model Updates

It is of upmost importance that RWPGs have the most up-to-date information available to make decisions. For example, the Brazos WAM that covers portions of Llano Estacado Region is used to determine both the DOR and the firm yield of reservoirs, but has not been updated in almost 20 years. The LERWPG recommends that the Texas Legislature approve a budget for TCEQ to pursue updated WAMs before the next regional planning cycle.

7.8.3 Monitoring and Assessment

The LERWPG recommends that entities monitor the drought situation around the state and locally in order to prepare for and facilitate decisions. Several state and local agencies are monitoring and reporting on conditions with up to date information. A few informative sources are listed below.

- PSDI: http://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/
- TWDB Drought Information: http://waterdatafortexas.org/drought/
- TCEQ Drought Information: https://www.tceq.texas.gov/response/drought

In addition, the LERWPG supports the efforts of the Texas Drought Preparedness Council administered by the Texas Department of Public Safety, and recommends that entities review information developed by the council. The Texas Drought Preparedness Council was established by the Texas Legislature in 1999 and is composed of 15 representatives from several state agencies. The council is responsible for assessing and public reporting of drought monitoring and water supply conditions, advising the governor on drought conditions, and ensuring effective coordination among agencies. More information on the Texas Drought Preparedness Council can be found here:

http://www.txdps.state.tx.us/dem/CouncilsCommittees/droughtCouncil/stateDroughtPrepCouncil.htm

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