Agenda Item 8a. Update on Water Management Strategies

Region F consultants continue to review and update water management strategies to meet the projected water needs for water users in Region F.

This agenda item will present an update on the evaluation of these strategies and include a review of two components of Chapter 5, Water Management Strategies:

1. Chapter 5C, Regional Water Management Strategies
    a. Overview of strategies applicable to water users across Region F, including subordination, brush control, and precipitation enhancement.
2. Major Water Provider Water Plans
    a. Summary of demands, supplies, and water management strategies implemented by the Major Water Providers in Region F, including:
        - Brown County WID #1
        - Colorado River Municipal Water District (CRMWD)
        - Midland
        - Odessa
        - San Angelo
        - Fort Stockton

Attachments:

1. Draft Chapter 5C, *Regional Water Management Strategies*

CHAPTER 5C

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Subchapter 5C Regional Water Management Strategies

Several strategies have been identified that will benefit multiple user groups across the region. These strategies include: subordination of downstream water rights, brush control, and precipitation enhancement. This subchapter discusses each of these strategies and outlines the recommendations, quantities and costs associated for each user of the strategy. Detailed strategy evaluations are included in Appendix C.

5C.1 Subordination of Downstream Senior Water Rights

The TWDB requires the use of the TCEQ Water Availability Models (WAM) for regional water planning. Most of the water rights in Region F are in the Colorado River Basin. Chapter 3 discusses the use of the WAM models for water supply estimates and the impacts to the available supplies in the Upper Colorado River Basin. The Colorado WAM assumes that senior lower basin water rights would continuously make priority calls on Region F water rights. That assumption is not consistent with the historical operation of the Colorado River Basin and likely underestimates the amount surface water supplies available in Region F.

Although the Colorado WAM does not give an accurate assessment of water supplies based on the way the basin has historically been operated, TWDB requires the regional water planning groups to use the WAM to determine supplies. Using WAM supplies causes several sources in Region F to have no supply by definition, even though in practice their supply may be greater than indicated by the WAM. According to the WAM, the Cities of Ballinger, Brady, Coleman, Junction, and Winters and their customers have no water supply. The Morgan Creek power plant has no supply to generate power. The Cities of Big Spring, Bronte, Coahoma, Midland, Miles, Odessa, Robert Lee, San Angelo, Snyder and Stanton do not have sufficient water to meet current demands. Overall, the Colorado WAM supplies show shortages that are the result of modeling assumptions and regional water planning rules and are inconsistent with the historical operation of the Colorado Basin. This would indicate Region F needs to immediately spend significant funds on new water supplies, when in reality the magnitude of the indicated water shortages

are not justified. Conversely, the WAM model shows more water in Region K (Lower Colorado Basin) than may actually be available.

One way for the planning process to reserve water supplies for these communities and their customers is to assume that downstream senior water rights holders subordinate their priority rights to major Region F municipal water rights, a strategy referred to as subordination in this plan.

Since the subordination strategy impacts water supplies outside of Region F, coordination with the Lower Colorado Regional Water Planning Group (Region K) was conducted. For the development of the 2006 regional water plans, a joint modeling effort was conducted with Region K and an agreement was reached for planning purposes. In subsequent planning cycles, Region K developed its own version of this subordination strategy, called the "cutoff model" that modified the priority dates for all water rights above Lakes Ivie and Brownwood. Region F has adopted the premise of the Region K's cutoff model with only minor variations for purposes of the subordination strategy in this plan. The Region F model makes two major assumptions: 1) senior water rights in the Lower Colorado Basin (Region K) do not make priority calls on the upper basin, and 2) these upper basin water rights do not make calls on each other. Figure 5C- 1 shows the divide between the upper and lower basin and depict which reservoirs were included in the subordination modeling. For the 2021 Region F Plan, the Region K model developed for LCRA with hydrology through December 2016 was used for the subordination modeling.

The Region F model differs from the Region K model by including the City of Junction's run-of-river rights in the upper basin. Other refinements to the subordination modeling include modifications for the Pecan Bayou. As discussed above, the assumption that upper basin water rights do not make calls on each other is consistent with general operations in the basin, but it may not be appropriate for determining water supplies during drought in the Pecan Bayou watershed. To better reflect reality, an assumption was made that the upstream reservoirs hold inflows that would have been passed to Lake Brownwood under strict priority analysis if Lake Brownwood is above 50 percent of the conservation capacity. This scenario provides additional supplies in the upper watershed while allowing Lake Brownwood to make priority calls at certain times during drought (i.e. when Lake Brownwood is below 50 percent of the conservation pool).

Two reservoirs providing water to the Brazos G planning region were included in the subordination analysis. Lake Clyde is located in Callahan County and provides water to the City of Clyde. Oak Creek Reservoir is located in Region F and supplies a small amount of water to water user groups within Regions F and G. Oak Creek Reservoir is owned and operated by the City of Sweetwater, which is in the Brazos G

Region. Both Clyde and Sweetwater have other sources of water in addition to the supplies in the Colorado Basin.

The subordination strategy modeling was conducted for regional water planning purposes only. By adopting this strategy, the Region F RWPG does not imply that the water rights holders have agreed to relinquish the ability to make priority calls on junior water rights. The Region F RWPG does not have the authority to create or enforce subordination agreements. Such agreements must be developed by the water rights holders themselves. Region F recommends and supports ongoing discussions on water rights issues in the Colorado Basin that may eventually lead to formal agreements that reserve water for Region F water rights.

The modeling shows that over 46,000 acre-feet of additional supply is available through the subordination strategy in 2020 and over 45,000 acre-feet in 2070. Table 5C- 1 compares the 2020 and 2070 Region F water supply sources with and without subordination.

Figure 5C- 1
Region F Subordination Strategy: Upper and Lower Colorado River Basins

Table 5C- 1
Region F Surface Water Supplies with and without Subordination

Reservoir Name	2020 Supply WAM Run 3	2020 Supply Subordination	2070 Supply WAM Run 3	2070 Supply Subordination
Lake Colorado City	0	1800	0	1550
Champion Creek Reservoir	0	1,170	0	1,100
Colorado City/Champion System	0	2,970	0	2,650
Lake Coleman	0	1,792	0	1,692
Hords Creek Lake	0	180	0	146
Coleman System	0	1,972	0	1,838
O. C. Fisher Lake[a]	0	0	0	0
Twin Buttes Reservoir[a]	0	1,670	0	1,195
Lake Nasworthy	0	See Twin Buttes	0	See Twin Buttes
San Angelo System	0	1,670	0	1,195
Lake J. B. Thomas (CRMWD System)	0	3,725	0	3,610
E.V. Spence Reservoir (CRMWD System)	0	21,575	0	21,355
O.H. Ivie Reservoir (CRMWD System)	14,285	15,193	11,709	13,067
O.H. Ivie Reservoir (Non-System)	16,065	17,147	13,491	15,053
O.H. Ivie Reservoir Total	30,350	32,340	25,200	28,120
CRMWD System Total (Thomas, Spence & Ivie)	14,285	40,493	11,709	38,032
Lake Ballinger / Lake Moonen	0	785	0	770
Lake Balmorhea	18,800	18,800	18,800	18,800
Brady Creek Reservoir	0	1,950	0	1,750
Lake Brownwood	18,900	24,340	18,200	23,770
Mountain Creek Reservoir	0	70	0	70
Oak Creek Reservoir	0	1,025	0	840
Red Bluff Reservoir	30,050	30,050	29,700	29,700
Lake Winters/ New Lake Winters	0	175	0	175
Junction ROR	0	250	0	250
TOTAL	***98,100***	***141,697***	***91,900***	***134,893***
Increase with Subordination	***43,597***		***42,993***	

[a] Supplies are less than theoretically available from the subordination model.

A list of the water user groups that could potentially benefit from subordination and the amount assumed for planning are shown in Table 5C- 2.

Table 5C- 2
Subordination Supplies by WUG

WUG Name	Additional Supplies Made Available through the Subordination Strategy					
	2020	2030	2040	2050	2060	2070
Ballinger [a]	794	751	750	748	753	791
County-Other, Runnels	23	21	19	18	18	19
North Runnels WSC	86	86	87	87	87	89
Brady	841	841	841	841	841	841
Steam Electric Power, Mitchell	1,170	1,156	1,142	1,128	1,114	1,100
Junction	250	250	250	250	250	250
Abilene	329	359	391	421	453	483
Midland [a]	2,173	359	391	421	453	483
Millersview-Doole WSC	52	0	0	0	9	62
Odessa	2,451	0	0	3,492	7,263	11,493
Ector County Utility District	234	0	0	332	694	1,097
Irrigation, Midland	3	0	0	2	6	8
Manufacturing, Ector	186	0	0	199	381	551
Steam Electric Power, Ector	109	0	0	114	219	316
Big Spring	611	0	0	647	1,233	1,785
Coahoma	51	0	0	56	105	152
Manufacturing, Howard	147	0	0	153	293	424
Steam Electric Power, Howard	21	0	0	22	40	59
Snyder	194	0	0	256	524	814
County-Other, Scurry	29	0	0	31	59	85
Rotan	18	0	0	17	32	46
Stanton	31	0	0	33	62	90
Irrigation, Ector [a]	157	0	0	162	312	449
Irrigation, Coleman	400	400	400	400	400	400
Coleman	1,319	1,296	1,276	1,255	1,227	1,200
Coleman County SUD	227	225	218	214	215	215
County-Other, Coleman	24	22	22	21	21	21
Manufacturing, Coleman	2	2	2	2	2	2
Bronte	202	201	199	197	197	197
Robert Lee	166	167	169	169	169	169
San Angelo [a]	1,875	1,819	1,766	1,709	1,656	1,600
Upper Colorado River Authority	43	37	33	30	27	23
Goodfellow Air Force Base	44	42	40	38	35	33
Manufacturing, Tom Green	37	36	32	29	26	22
Winters	100	99	98	98	98	97
Brady Creek (non-allocated)	1,109	1,069	1,029	989	949	909
BCWID (non-allocated)	5,440	5,466	5,492	5,518	5,544	5,570
CRMWD (non-allocated)	20,122	26,330	26,355	20,868	15,167	8,954
Mountain Creek (non-allocated)	70	70	70	70	70	70
Oak Creek (non-allocated)	657	620	583	548	511	474
Lake Colorado City (non-allocated)	1,800	1,750	1,700	1,650	1,600	1,550

[a] Includes subordination supplies from multiple sources and/or providers.

The reliability of this strategy is considered to be medium based on the uncertainty of implementing this strategy. The subordination strategy defined for the Region F Water Plan is for planning purposes. If an entity chooses to enter into a subordination agreement with a senior downstream water right holder, the details of the agreement (including costs, if any) will be between the participating parties. Therefore, strategy costs were not determined for the subordination strategy. For planning purposes, capital and annual costs for the subordination strategy are assumed to be $0.

5C.2 General Water Management Strategies

5C.2.1 Brush Control

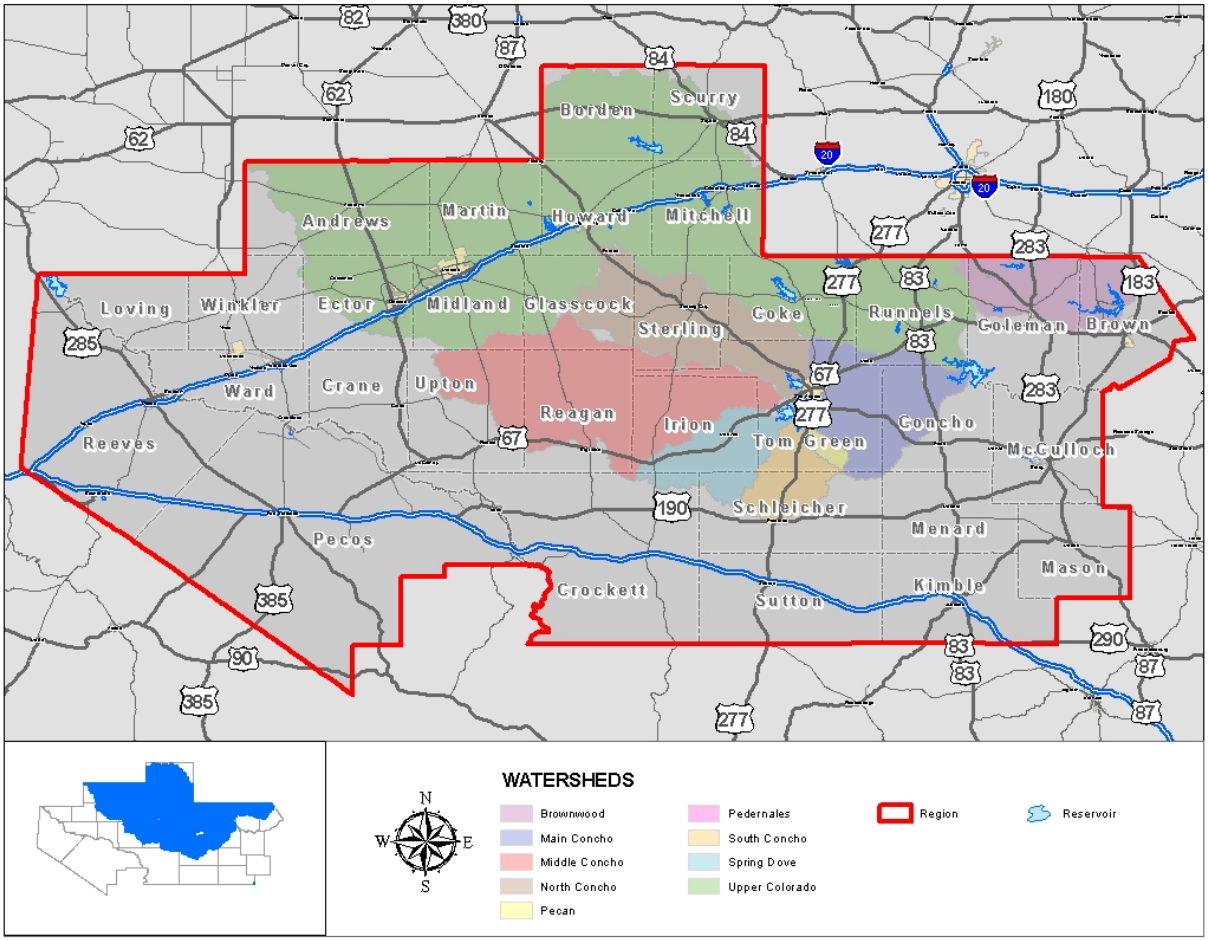
Brush control has been identified as a potentially feasible water management strategy for Region F. It has the potential to enhance the existing supply from the region's reservoirs.

In 1999, the Texas State Soil and Water Conservation Board began the Brush Control Program. In 2011, the 82nd Legislature replaced the Brush Control Program with the Water Supply Enhancement Program (WSEP). The WSEP's purpose is to increase available surface and groundwater supplies through the selective control of brush species that are detrimental to water conservation. The WSEP considers priority watersheds across the State, the need for conservation within the territory of a proposed projection based on the State Water Plan and if the Regional Water Planning Group has identified brush control as a strategy in the State Water Plan as part of their competitive grant, cost sharing program. Three primary species are eligible for funding from the WSEP: juniper, mesquite and salt cedar.

For a watershed to be eligible for cost-share funds from the WSEP, a feasibility study must demonstrate increases in projected post-treatment water yield as compared to the pre-treatment conditions. Feasibility studies have been conducted and published for the following watersheds in Region F and are shown on Figure 5C-2:

- Lake Brownwood
- North Concho River (O.C. Fisher Lake)
- O.H. Ivie Reservoir (Lake Basin)
- O.H. Ivie Reservoir (Watershed, Upper Colorado River and Concho River)
- E.V. Spence (Upper Colorado River)
- Lake J.B. Thomas (Upper Colorado River)
- Twin Buttes Reservoir (including Lake Nasworthy)
- Upper Llano River, including South and North Llano Rivers and Junction City Lake

Figure 5C- 2
Brush Control Watershed Feasibility Studies



Active brush removal has been implemented in several watersheds, but to be an effective and reliable long-term water production strategy, areas where brush removal has been performed, must be maintained. These maintenance activities qualify as brush control for purposes of this plan.

Although many studies have illustrated the benefits of brush control, it is difficult to quantify the amount of water supply created by the strategy for regional water planning. This quantification is important because in most areas where the program is being implemented, hydrologic records indicate long term declines in reservoir watershed yields (some as much as 80%). Region F has been in serious drought conditions during most of the time that the region's brush removal programs have been in place, so the monitoring programs associated with these projects may not have shown significant gains due to the lack of rainfall events. Also, the benefits from brush control are long term; it takes time for aquifers to recharge and it may take some time for watersheds to return to pre-brush conditions.

For purposes of this plan, brush control is recommended for the following sponsors and watersheds. The quantity of water directly associated with brush removal under drought conditions is limited since it is reliant on rainfall, but it is assumed that this strategy will increase the reliability of the surface water supplies made available through subordination. It may also help increase supplies when employed as part of a conjunctive strategy. By heavily using surface water when it is available, groundwater is preserved for times of future drought.

Table 5C- 3
Region F Brush Control

Sponsor	Watershed	Annual Cost	Quantity (acre-feet per year)
UCRA	O.H. Ivie	$51,000	60
San Angelo	Twin Buttes Reservoir	$44,000	90
BCWID	Lake Brownwood	$156,000	400

5C.2.2 Weather Modification

Weather modification is a water management strategy currently used in Texas to increase precipitation released from clouds over a specified area. Typically, weather modification is practiced during the dry summer months when conditions are most favorable. The most common form of weather modification or rainfall enhancement is cloud seeding. Early forms of weather modification began in Texas in the 1880s by firing cannons to induce convective cloud formation. Current cloud seeding techniques are used to enhance the natural process for the formation of precipitation in a select group of convective clouds.

Weather modification is most often utilized as a water management strategy during the dry summers in West Texas, with the season beginning in March and ending in October. The water produced by weather modification augments existing surface and groundwater supplies. It also reduces the reliance on other supplies for irrigation during times of normal and slightly below normal rainfall. However, not all of this water is available for water demands. Some of this precipitation is lost to evaporation, evapotranspiration, and local ponds. During drought years the amount of additional rainfall produced by weather modification may not be significant. However, by using this strategy during normal rainfall years, groundwater is preserved for use during future times of drought.

The amount of water made available to a specific entity from this strategy is difficult to quantify, yet there are regional benefits. Four major benefits associated with weather modification include:

- Improved rangeland and agriculture due to increased precipitation
- Greater runoff to streams and rivers due to higher soil moisture
- Groundwater recharge
- Hail suppression

In Region F, there are two ongoing weather modification programs: the West Texas Weather Modification Association (WTWMA) project and the Trans Pecos Weather Modification Association (TPWMA) program. Figure 5C-3 shows the counties that are currently participating in weather modification programs.

Based on data collected from the WTWMA program, precipitation increases across participating counties in 2016 varied from slightly less than 0.5 inches to over 2 inches in the year, averaging 2.02 inches of increased rainfall. [1] This represented over a 10 percent increase in rainfall. In the Trans Pecos area, the rainfall increases were less, averaging 0.43 inches of increased rainfall.[2]

While it is difficult to quantify the benefits to individual water user groups, weather modification is a recommended strategy for irrigated agriculture for counties that currently participate in an active program. It is assumed that the increase in rainfall will offset irrigation water use. To determine the water savings associated with this strategy, an estimate of the increase in annual rainfall over the typical growing season is applied directly to the irrigated acreages. [3] These savings are shown by county in Table 5C- 4.

The reliability of water supplies from precipitation enhancement is considered to be low for two reasons. First, it is uncertain how much water is made directly available per water user. Second, during drought conditions precipitation enhancement may not result in a significant increase in water supply. However, water saved due to precipitation enhancement will preserve local groundwater for future use.

The cost of operating Texas weather modification programs are approximately 4 to 6 cents per acre. For planning purposes, it was assumed that it would cost 4.5 cents per acre. These costs are supported by local municipalities, groundwater districts, irrigation districts, and landowners. The costs shown in Table 5C- 4 are based on the program cost for the irrigated acres. Actual costs would be higher when considering the entire program areas.

Figure 5C- 3
Current Weather Modification Programs

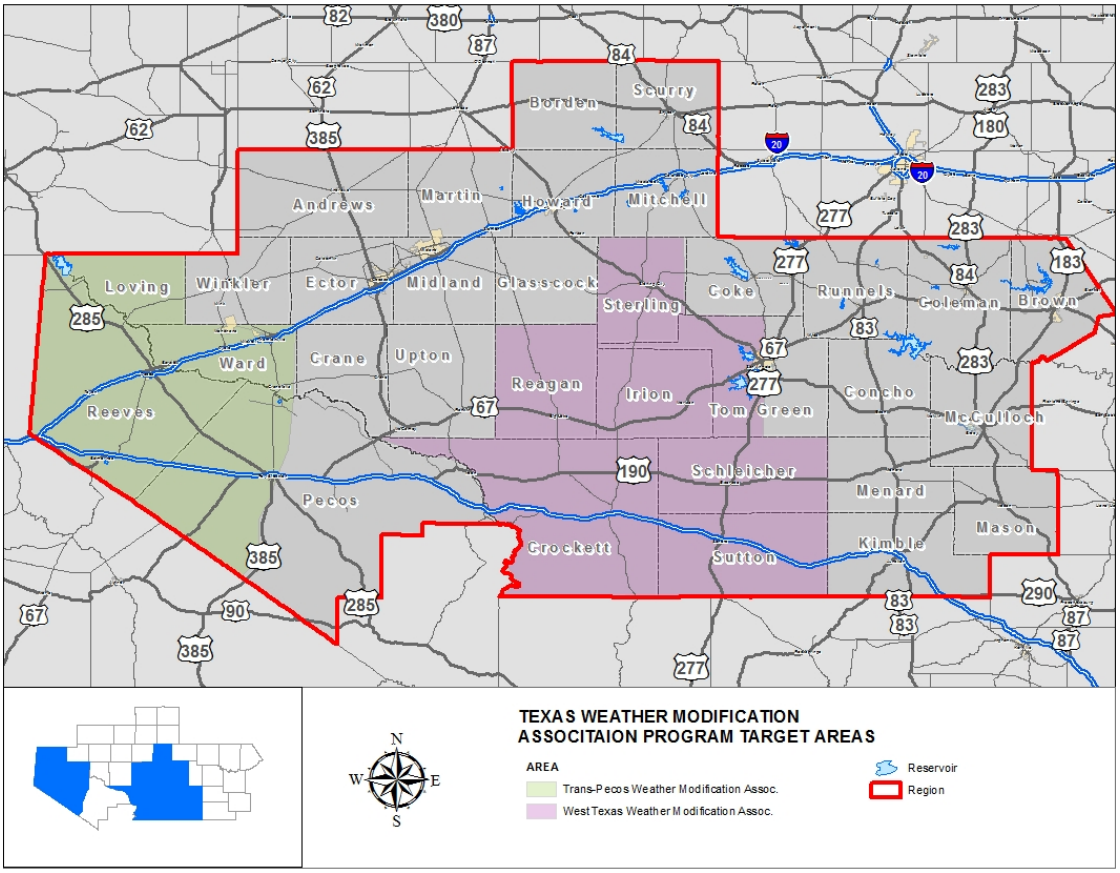


Table 5C- 4
Weather Modification Water Savings and Cost

Weather Modification Program	County	Water Savings (ac-ft/yr)	Cost ($)	Cost per Ac-Ft ($/ac-ft)
TPWMA	Pecos	106	$580	$5.45
TPWMA	Reeves	326	$366	$1.13
TPWMA	Ward	259	$147	$0.57
WTWMA	Crocket	1	$1	$0.47
WTWMA	Irion	202	$42	$0.21
WTWMA	Reagan	1,869	$364	$0.19
WTWMA	Schleicher	275	$64	$0.23
WTWMA	Sterling	48	$18	$0.39
WTWMA	Sutton	34	$15	$0.45
WTWMA	Tom Green	2,007	$882	$0.44
TOTAL		**5,128**		**$0.48**

Source: Texas Weather Modification Association[4]

LIST OF REFERENCES

[1] West Texas Weather Modification Association. *2017 Annual Report for West Texas Weather Modification Association*.

[2] Texas Weather Modification Courier, February 2014. <http://www.texasweathermodification.com>.

[3] United States Department of Agriculture, National Agricultural Statistics Service. "2017 Census of Agriculture, Texas State and County Profiles." Rep. <http://www.agcensus.usda.gov/Publications/2017/>

[4] Arquimedes Ruiz Columbie. Active Influence & Scientific Management, *Annual Evaluation Report 2016 State of Texas*. Prepared for the Texas Weather Modification Association. <http://www.texasweathermodification.com>.