

#### **4B.10 Weather Modification**

Weather modification is a water management strategy currently used in Texas to increase precipitation released from clouds over a specified area typically during the dry summer months. The most common form of weather modification or rainfall enhancement is cloud seeding. Cloud seeding is used to enhance the natural process for the formation of precipitation in a select group of convective clouds. Convective clouds, also known as cumulus clouds, are responsible for producing the bulk of rainfall during any given year in Texas.<sup>1</sup> The cloud seeding process increases the availability of ice crystals, which bond with moisture in the atmosphere to form raindrops, by injecting a target cloud with artificial crystals, such as silver iodide. Specially equipped aircraft release the seeding crystals into clouds that are rich in supercooled droplets. The silver iodide crystals form water droplets from available moisture in the air. Droplets then collide with droplets transforming the ice crystal into a raindrop.

While weather modification is most often utilized as a water management strategy during the dry summers in West Texas, the amount of additional rainfall produced by cloud seeding in a drought year is much less. The water that cloud seeding produces during non-drought periods 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. The amount of water made available to a specific entity from this strategy is difficult to quantify, yet there are regional benefits. Three 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

One ongoing weather modification program is partially located in the Brazos G Area, the Colorado River Municipal Water District rain enhancement project. A second weather modification program, conducted by the West Central Texas Weather Modification Association, was started in 2001, but due to budgetary issues, was stopped after the 2003 season.

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<sup>1</sup> Texas Department of Licensing and Regulation's Website <http://www.license.state.tx.us/weather/weathermod.htm>. October 5, 2004.

The Colorado River Municipal Water District (CRMWD) rain enhancement project is based in Big Spring and has been active since 1971. It seeds clouds in a 2.6 million acre target area. Even though Big Spring is located in Region F, the target area of the project is the area between the cities of Big Spring, Lamesa, Snyder, and Sweetwater. The City of Sweetwater and a small portion of the target area are located in Region G.

Both increased rainfall and higher cotton yields within the target area have been attributed to the CRMWD rain enhancement project during the life of the project. According to the CRMWD website, the precipitation data indicate a 35 percent average increase in rainfall at rainfall stations within the target area. This can be compared to a 12 percent average increase in rainfall at weather stations outside of the target area. Precipitation and crop yield data from more recent years indicate that cotton yields have increased an average of 44 percent for counties in the cloud seeding area. In addition, a 37 percent increase in production was also reported for counties downwind of seeding activities, whereas only a 6 percent increase was reported for counties upwind of the program<sup>2</sup>.

The West Central Texas Weather Modification Association's program, sponsored by an alliance of nine counties and the City of Abilene, performed cloud seeding activities over 4.9 million acres in nine counties during the 2001 -2003 seasons. Five of these counties, including Nolan, Taylor, Callahan, Eastland, and Comanche, are located in Region G. The program conducted seeding activities between May 1 and September 30 of the year. The 2003 operating budget was \$496,000, of which a portion was provided by a grant from the State of Texas<sup>3</sup>.

Since the West Central Texas Weather Modification program was active for only three seasons, documented data are limited. According to Tom Mann of the West Central Texas Council of Governments, during the three years of the program, there was a 62 percent average increase in normal precipitation recorded that generated an average of 40,550 acre-feet of additional rainwater. Even though 2002 was a drought year in the study area, there were more opportunities for cloud seeding, which resulted in a higher yield from the program.

Successful rainfall enhancement programs can improve dryland farming, reduce irrigation for irrigated acres, improve forage and potentially increase runoff to local streams and reservoirs. According to the Texas Agricultural Statistics Service, within the West Central Texas

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<sup>2</sup> Colorado River Municipal Water District's Weather Modification Program Website: <http://www.crmwd.org/wxprog.htm>. October 12, 2004.

<sup>3</sup> Kiel, Simone of Freese and Nichols, Inc., Email with Tom Mann, West Central Council of Governments, July 22, 2003.

target area there are over 51,500 acres of irrigated agriculture, 632,400 acres of dryland farming, and 355,000 head of cattle. A study by Texas A&M University on the economic impacts of weather modification found that an additional one inch of rainfall distributed evenly over the target area would result in over \$10 million in benefits per year<sup>4</sup>. The increases in rainfall recorded to date, if distributed uniformly over the target area, correspond to 0.0068 inches in 2001 and 0.011 inches in 2002. In 2003, seeded clouds produced 1.5 inches more rainfall than similar unseeded clouds. While the economic benefits cannot be proportioned directly, the benefits associated with these levels of increased rainfall would be substantially less than \$10 million.

The cost of operating the weather modification program is approximately 10 cents per acre. Benefits of the program are widespread and are difficult to quantify for specific entities within Region G. As such, weather modification is not recommended to meet a specific need at this time. However, if the West Central Texas Weather Modification program is reinstated, it is recommended that the counties in Region G within the target area support the program. This would allow additional data to be collected to determine if weather modification could be used as a long-term water management strategy in the region.

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<sup>4</sup> Kiel, Simone of Freese and Nichols, Inc., Email with Tom Mann, West Central Council of Governments, September 2, 2003.

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