

NOAA Technical Memorandum NWS SR-189

**WOLF CREEK FLOOD OF SEPTEMBER 17-19, 1996**

Steve Drillette  
NWSFO Lubbock, TX

Lance Goehring  
NWSO Amarillo, TX

Scientific Services Division  
Southern Region  
Fort Worth, TX

June 1997



## WOLF CREEK FLOOD OF SEPTEMBER 17-19, 1996

### **Introduction.**

Wolf Creek (Fig. 1) is a small watershed creek which originates in Ochiltree County, and flows through Lipscomb County (both part of Amarillo's Hydrologic Service Area) and then into northwest Oklahoma. This report will detail the events which led up to the record flooding which occurred along Wolf Creek on September 18, 1996. This flood resulted in an estimated \$500,000 in property damage in Ochiltree and Lipscomb Counties in the northeast Texas Panhandle. Figure 2 shows the WSR-88D estimated and the observed rainfall for this event. Circumstances that resulted due to the flood, the magnitude and damage of the flood and findings and recommendations for ways to mitigate the potential hazards posed by flooding are also discussed.

### **Setting the stage.**

Wolf Creek flows into the North Canadian River at Fort Supply in northwest Oklahoma. Several homes and ranches lie along Wolf Creek in Ochiltree County. Lake Fryer, a small man-made lake about 15 miles south of Perryton, lies along Wolf Creek in southeast Ochiltree County. This lake is the primary recreational attraction at Wolf Creek County Park which is used for camping, boating, picnicking and other activities.

The topography of the region is composed of gently rolling hills with deep creek channels. Many smaller tributaries run into Wolf Creek as the creek makes its way to Lake Fryer (Fig. 1). Further downstream the topography becomes flatter, with the creek channels becoming progressively wider as the creek makes its way across Lipscomb County. Figure 3 shows photos taken after the flood at Lake Fryer and downstream locations. An automated USGS river gauge is located along the creek at Lipscomb in central Lipscomb County. This site is currently not a river forecast point; and at the time of this event, little flood information was available.

The city of Lipscomb has never reported flooding within the city limits. However, Glen Turner Memorial Park lies just downstream from the gauging site. This is a city park which has picnic and rest room facilities. Although the park is rarely occupied, there are times when picnicking and primitive camping occur.

### **Meteorological conditions.**

During the evening and early morning hours of September 17-18, strong thunderstorms which had developed during the late afternoon of the 17th in the central Texas Panhandle moved into Ochiltree County. Thunderstorms continued to develop and increase in intensity as they moved over the same areas during the overnight hours. Watches, warnings, and related products issued by the Amarillo NWS office during this event can be found in Table 1.

**TABLE 1**

<b>*PRODUCT ISSUED</b>	<b>VALID TIME</b>	<b>RESPONSIBLE AGENCY</b>	<b>LOCATIONS SPECIFIED</b>
<b>Excessive Rainfall Potential Outlook</b>	2230 (9/17) until 0700 (9/18)	National Center of Environmental Prediction Silver Springs, MD	Southern Plains from eastern Colorado to western Oklahoma
<b>Tornado Watch</b>	2200 (9/17) until 0400 (9/18)	Storm Prediction Center Kansas City, MO	TX & OK Panhandles
<b>Severe Thunderstorm Warning</b>	2351 (9/17) until 0055 (9/18)	NWS (National Weather Service) - Amarillo	Ochiltree County
<b>Urban and Small Stream Flood Advisory</b>	0033 (9/18) until 0530 (9/18)	NWS - Amarillo	Ochiltree County
<b>Tornado Warning</b>	0100 (9/18) until 0205 (9/18)	NWS - Amarillo	Ochiltree County
<b>Severe Thunderstorm Warning</b>	0209 (9/18) until 0315 (9/18)	NWS- Amarillo	Ochiltree County
<b>Flash Flood Warning</b>	0315 (9/18) until 0615 (9/18)	NWS - Amarillo	Hansford, Lipscomb and Ochiltree Counties
<b>Urban and Small Stream Flood Advisory</b>	0602 (9/18) until 0900 (9/18)	NWS - Amarillo	Ochiltree County
<b>Flash Flood Watch</b>	1522 (9/18) until 1800 (9/19)	NWS - Amarillo	Ochiltree, Lipscomb and surrounding Counties
<b>Flash Flood Warning</b>	1529 (9/18) until 1930 (9/18)	NWS - Amarillo	Ochiltree Counties
<b>Flash Flood Warning</b>	2334 (9/18) until 0330 (9/19)	NWS - Amarillo	Hansford, Ochiltree and northern Hutchison Counties
<b>River Flood Warning</b>	0003 (9/19) until daybreak	NWS - Amarillo	Lipscomb county

\* Short Term Forecasts highlighting the flooding were periodically issued for Ochiltree and Lipscomb Counties throughout this event.

At 0000 UTC, the approximate time of the initial thunderstorm development, a strong 500 mb low was over southeast Idaho. This low was nearly vertically stacked to 200 mb. A 700 mb low was developing over north central Colorado, with an associated trough extending south into central New Mexico. An 850 mb low was located over southern Colorado. A surface low was rapidly developing over southeast Colorado.

At the same time, a Pacific cold front extended from the surface low southwestward across central New Mexico. A surface dryline extended from the low south through the western third of the Texas Panhandle, about 60 miles west of Ochiltree County. A stationary front extended from the low southeastward into central Texas. The surface dryline remained quasi-stationary throughout the event.

Temperatures across the northern Texas Panhandle were in the mid 70s. Dewpoint temperatures were in the low to mid 60s. Surface winds were from the southeast at 20 mph, and veered with height. At 300 mb, the winds were southwest around 40 kt.

These conditions relate closely to the "synoptic flash flood type" (Maddox 1979). A comparison of the meteorological conditions on September 17 and the mean conditions of the synoptic flash flood type as presented by Maddox is found in Table 2. Actual analyses and Maddox synoptic flash flood meteorological analyses are compared for the surface, 850 mb and 500 mb in Figs. 4-6.

**TABLE 2**

LEVEL	MADDOX TEMP	ACTUAL TEMP	MADDOX DEWPT	ACTUAL DEWPT	MADDOX WIND DIR	ACTUAL WIND DIR	MADDOX WIND SPEED	ACTUAL WIND SPEED
SURFACE	74 F	74 F	67 F	63 F	165	160	13 kt	20 kt
850 mb	17 C	15 C	2 C	2 C	195	175	32 kt	30 kt
700 mb	5 C	8 C	*3 C	*3 C	215	200	36 kt	30 kt
500 mb	-11 C	-10 C	*8 C	*8 C	220	200	47 kt	30 kt
300 mb	-38 C	-39 C	*7 C	*7 C	230	230	57 kt	55 kt
200 mb	-57 C	-57 C	NA	*7 C	235	240	66 kt	65 kt

\* Dewpoint Depressions

Radar estimated as much as 8 in of rain fell across the headwaters of Wolf Creek during the evening and early morning hours of September 17-18, with an unofficial gauge report of around 11 in. Wolf Creek County Park reported around 6 in. As seen in Fig. 2, a comparison with the limited ground truth reports indicated the WSR-88D performed quite well overall. A few areas along the northern side of the heavy rain band were underestimated by about 1 in.

**What actually happened at Wolf Creek County Park?**

Around midnight, the Ochiltree County sheriff deputy and the county commissioner drove to Wolf Creek County Park to inform the park concessionaire of the severe weather conditions. The concessionaire and his wife were camping along the lake in their recreational vehicle (RV). The deputy and commissioner reported that a tornado watch was in effect, and a storm with large hail was approaching.

There were six additional RVs in the park. Upon learning of the ominous weather, the concessionaire and the deputy alerted the campers. The concessionaire, his wife and all of the campers, except for one couple, retreated to the park restaurant. Shortly after 0100 CDT, the sheriff's office called the park and informed the people in the restaurant that a tornado warning had been issued. Around 0300 CDT, the sheriff's office called them to convey that the warning had expired, the last in a series of storms was passing over, and improving weather could be expected.

No other contacts were made between the sheriff's office and the park until after sunrise. The park guests had returned to their RVs around 0330 CDT, since the threat of severe weather seemed to be

over. The concessionaire and his wife retired for the night in their home located next to the restaurant around 0400 CDT.

Around 0630 CDT, one camper noticed that water was on the rise and began making preparations to move his RV. By 0700 CDT, the water was too high and rising too fast for him to save his RV. Fortunately, he and his wife were able to drive to safety and warn the campers in a nearby fifth-wheel trailer. The occupants of the fifth-wheel also managed to drive away safely in water up to the doors of their pickup.

Upon reaching safety, they tried to warn the occupants in a nearby pop-up camper of the rising water. A lady inside this camper was awakened by water lapping at her neck. She and her husband were able to rescue themselves by forcing their way through an emergency exit window and wading to safety through water 4 to 5 ft deep.

The concessionaire was awakened by a phone call from the sheriff's office at 0740 CDT. The dispatcher reported that U.S. Highway 83 was closed. Flooding of U.S. Highway 83 resulted in extensive damage to the road and bridge where it crosses Wolf Creek (Fig. 3g). The concessionaire quickly made his way outside and found almost the entire park under water.

Around 0800 CDT, both RVs that were first evacuated were drawn into the lake and eventually carried over the spillway. The concessionaire, who was trapped on the opposite side of the lake, saw both units and was concerned that they were still occupied. Fortunately, there were no injuries or fatalities. However, of the seven RVs at the park, two were carried downstream, three were considered total losses, and two escaped with little or no damage (Figs. 3c and 3d).

When the flood crested around 0900 CDT September 18, water poured over the spillway 8 ft deep and came within 2 ft of topping the spillway structure. The flooding at Wolf Creek County Park began to gradually recede an hour later, but water continued to flow over the spillway by several feet until the next morning.

Flooding also occurred in Ochiltree County in areas upstream and downstream from Wolf Creek County Park. Several residences and ranches experienced flooding. Several of the residents downstream of Lake Fryer had to be evacuated by helicopter as their homes became islands. Many roads were also flooded. The flooding caused significant damage to the road surfaces along U.S. Highway 83 (Fig. 3g) and FM Road 759 (a few miles south of the location of Fig. 3g—see Fig. 1 for map).

#### **What happened at Lipscomb?**

Movement of the flood wave crest from Lake Fryer (1000 CDT September 18) to the gauging site at Lipscomb (0100 CDT September 19) took about 15 hr. Little information from previous floods was known for this site. The first indication of rising water was received at 2330 CDT September 18 from a HYDROMET alert. A stage of 10.47 ft was reported. Based on record flood stage information alone, a river flood warning was issued at 0003 CDT September 19. The river crested at a height of 12.44 ft at 0100 CDT. The stage went from 4.03 ft at 1630 CDT to 12.44 ft at 0100 CDT the following day (Fig. 7). The highest stage during the period of record was 11.57 ft in 1941.

Records were discontinued from 1942 until 1961, but a stage of 15.5 ft was estimated by the USGS in 1957 from high water marks.

A survey of the site after the flood (Fig. 3h) indicated that Glen Turner Memorial Park, a city park located just downstream of the gauging site, had flooded. Water as high as 4 ft deep encompassed the park. A secondary creek also flows into the park and joins Wolf Creek from the south. The park was unoccupied during the flood; however, a swing set was destroyed, and some wooden picnic tables and benches were washed away.

The survey indicated that Wolf Creek would begin to flood the park at a stage of around 9.5 ft, and the flooding could be aggravated by high flows in the secondary creek. Stages along Wolf Creek over 10.0 ft would threaten nearby ranch land. A secondary road that leads to the park would begin to flood at 15.0 ft. All other roads and structures in the immediate area, including the city of Lipscomb, appeared to be above the confirmed record flood stage of 15.5 ft.

### **Summary**

Undoubtedly, the flooding that occurred along Wolf Creek, and specifically at Wolf Creek County Park, was an extremely rare event since comparable floods have occurred only twice this century—1947 and 1957. Both of those earlier floods were during a period when stage records were not being kept. The 1947 flood, which may have resulted in the worst flooding, was partially due to the failure of the Lake Fryer dam. The 1957 flood occurred shortly before the new dam construction was completed and was probably not as extensive as the 1996 flood. The park concessionaire, in his six years at Wolf Creek County Park, reported that the campgrounds at the park have experienced only minor flooding in the past, but nothing close to this magnitude. The recorded gauge height of 12.44 ft at Lipscomb surpassed the old period of record stage of 11.57 ft set in 1941.

It was extremely fortunate that no lives were lost. It is possible that more communication between the NWS, the Perryton sheriff's office and the Wolf Creek County Park could have resulted in less property damage, especially to the RVs involved. The initial warnings and statements issued by the NWS in Amarillo seemed to be timely and appropriate. However, as this event progressed, forecasters at the NWS in Amarillo were not aware of the seriousness and the magnitude of the flood. This was primarily a result of communication gaps between the Amarillo NWS and Ochiltree County officials.

The fact that flooding of this magnitude is rare should not downplay the importance of warning these areas that may be threatened. If this had been a holiday weekend when the park is full, this event could easily have had a more tragic ending.

### **Concluding remarks**

Wolf Creek County Park is open year round. Visitors occupy the park on a regular basis. Campgrounds in the park have a history of minor flooding. The park and several homes along it had been flooded for some time before this information was received by the NWS in Amarillo. It is imperative that all information pertinent to a developing or occurring flood or flash flood event be expeditiously passed on to the local NWS office with forecast, watch, and warning responsibility for

the area. Equally important, the NWS and local government agencies must continue to pursue ways to maximize the dissemination of this information.

Forecasters, however, do not need to wait for local officials to call. If a forecaster even suspects flooding might be possible, or occurring, he or she should try to call local contacts periodically to keep abreast of conditions. Specific questions from the NWS, such as "Are there any homes flooded" or "What is the flooding situation at Wolf Creek Park" may elicit more specific information, especially if there is reason to believe those in the affected area may be preoccupied by a current tornado warning.

All information received by the NWS should be relayed to the lead forecaster on duty. If there is any doubt as to the significance of the information, follow-up (clarification) calls should be made.

After a heavy rain event it may take several hours for runoff to accumulate in a significant creek or river. Therefore, water along a creek or river may continue to rise, and *flooding may occur downstream* hours after the rain has ceased or where little or no rain has fallen. While certainly not a new concept to NWS forecasters, areas where this type of "lag" behavior persistently occurs in a WFO's hydrologic service area should be outlined. Forecasters should also remain aware of the flood threat downstream of where heavy rains fall.

#### **Acknowledgments**

Thanks to Larry and Dawn Money, Ken Donahue, Willis Smith, Jim Hudson, and the Woodward, Oklahoma, USGS office for their time in providing us with information in regard to this flooding event. We also are most grateful for the pictures and videos provided. In addition, we would like to thank José García (MIC, NWSO Amarillo), Doug Crowley (WCM, NWSO Amarillo), Andy Anderson (MIC, NWSFO Lubbock), Larry Vannozi (WCM, NWSFO Lubbock), and Loren Phillips (SOO, NWSFO Lubbock) for their input. A special thanks to Fred Zeigler (Intern, NWSO Amarillo) for his assistance with the flood survey at Lipscomb.

#### **References**

Maddox, R. A., 1979: A methodology for forecasting heavy convective precipitation and flash flooding. *NWA Digest*, 4, 30-42.

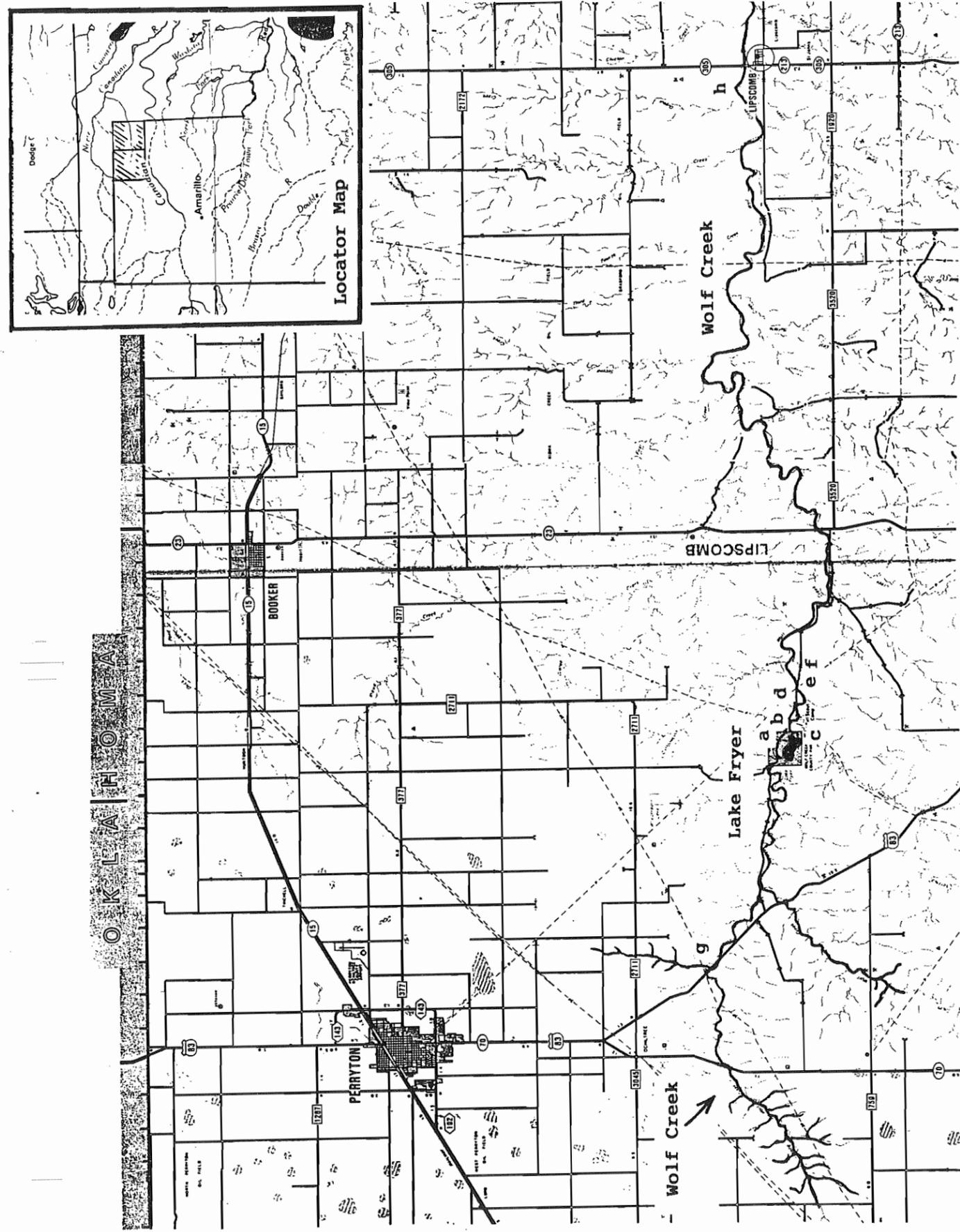


Fig. 1. Map of the northeastern portion of the Texas Panhandle, showing area of flood on Wolf Creek. Letters indicate locations of photos shown in Fig. 3. Ochiltree (l) and Lipscomb (r) Counties are the small cross-hatched squares in the inset locator map.

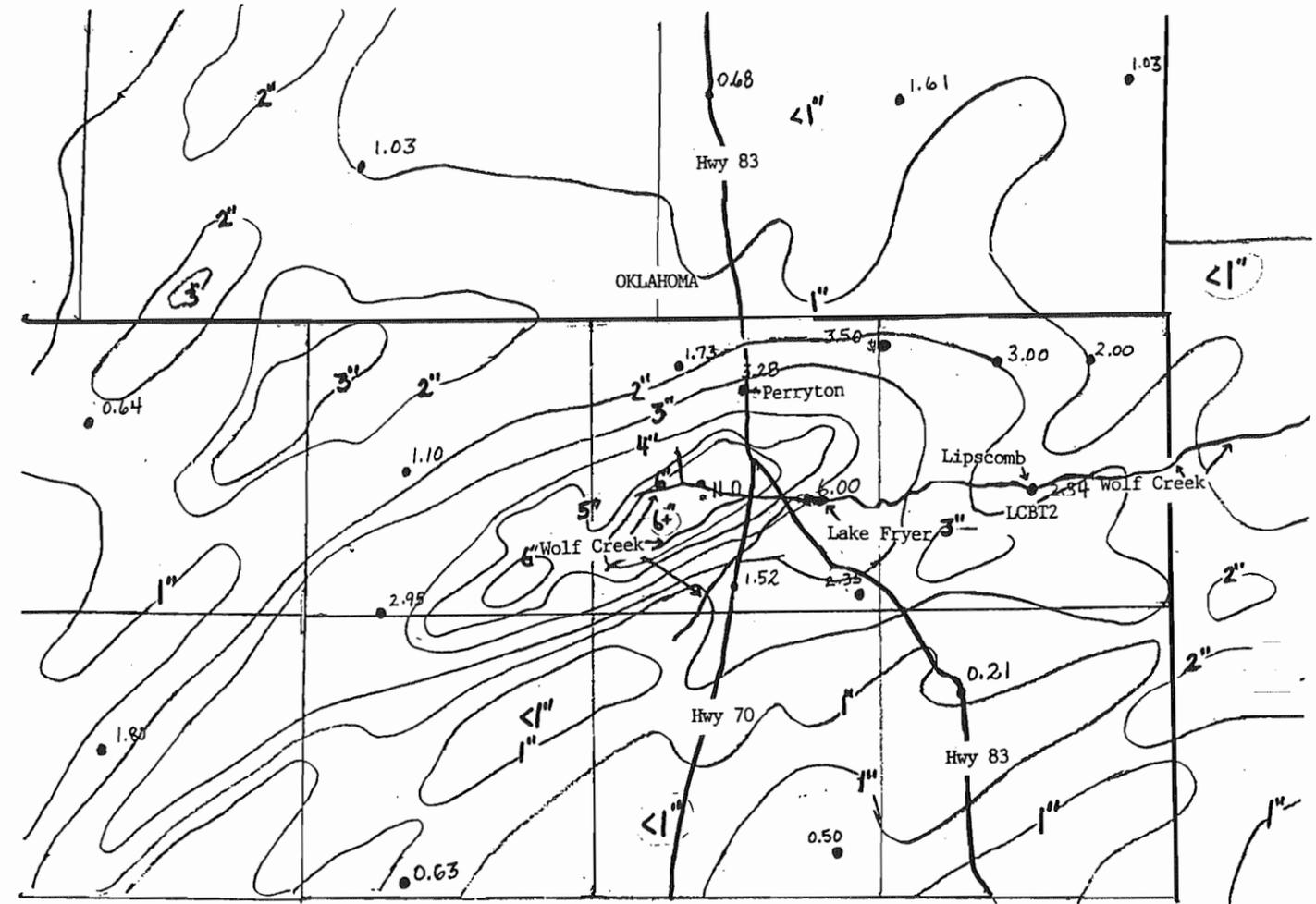
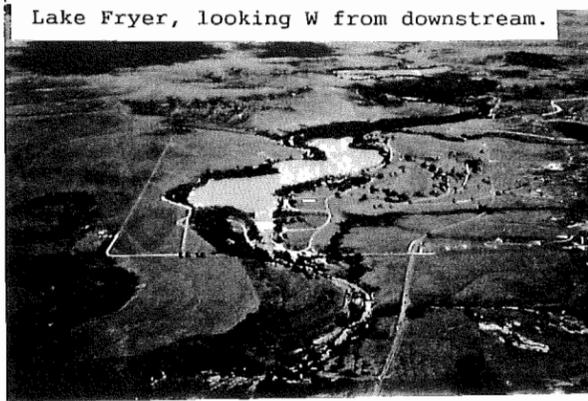
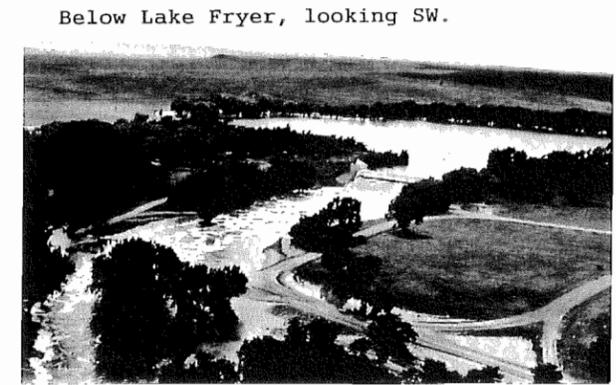


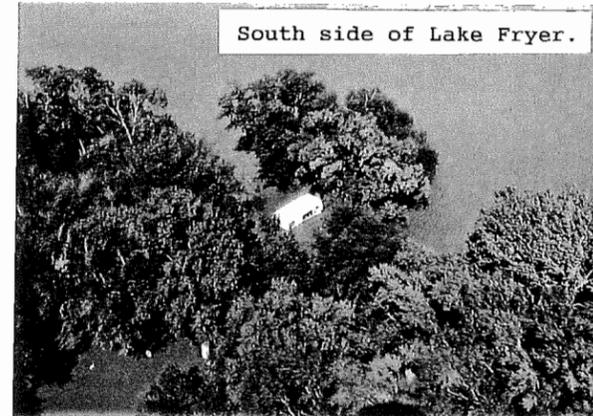
Fig. 2. Isohyets based on contouring the Storm Total Precip product from the Amarillo WSR-88D, with plotted rainfall reports available from the flood area.



a



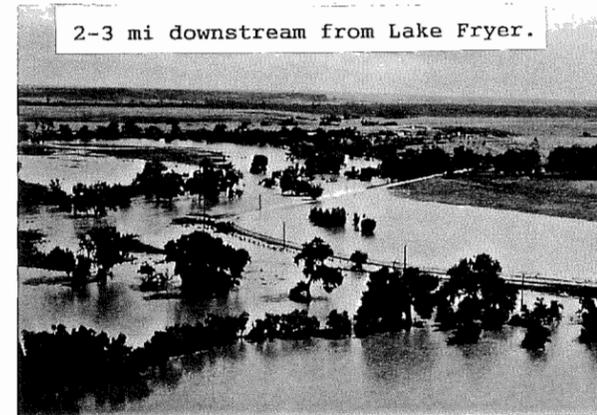
b



c



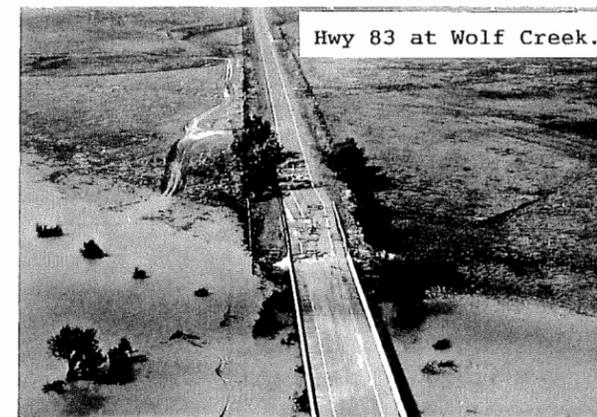
d



e



f



g



h

Fig. 3. Photos of Wolf Creek, showing damage.



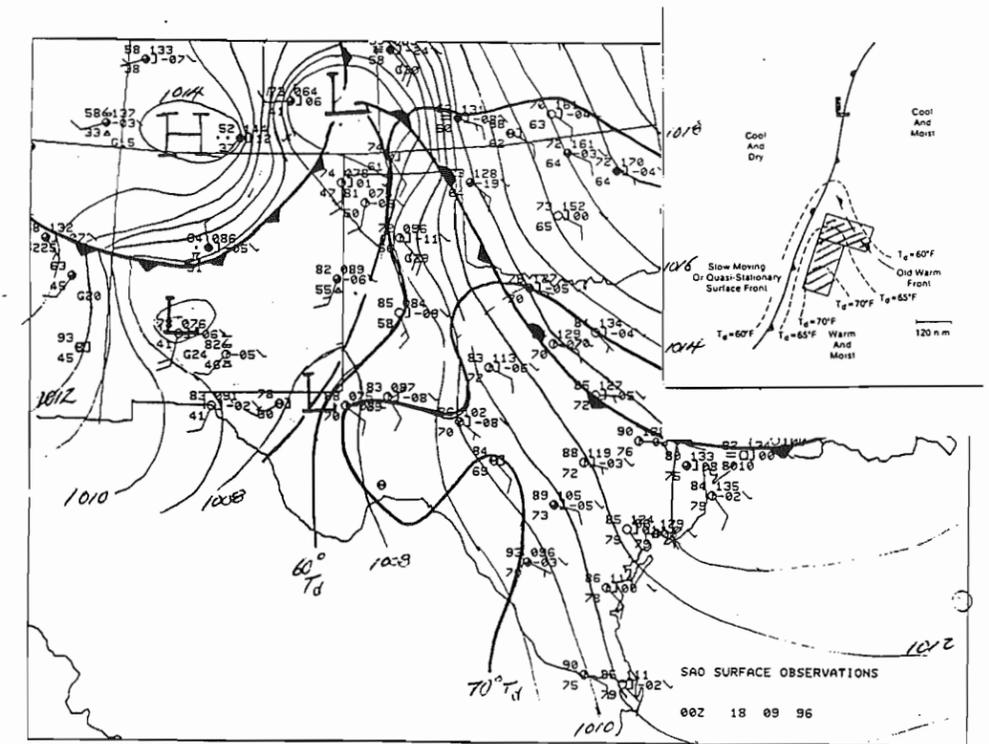


Fig. 4. Surface analysis for 0000 UTC September 18, 1996. Inset: Maddox typical flash flood event (possible flood watch area shown as shaded rectangles).

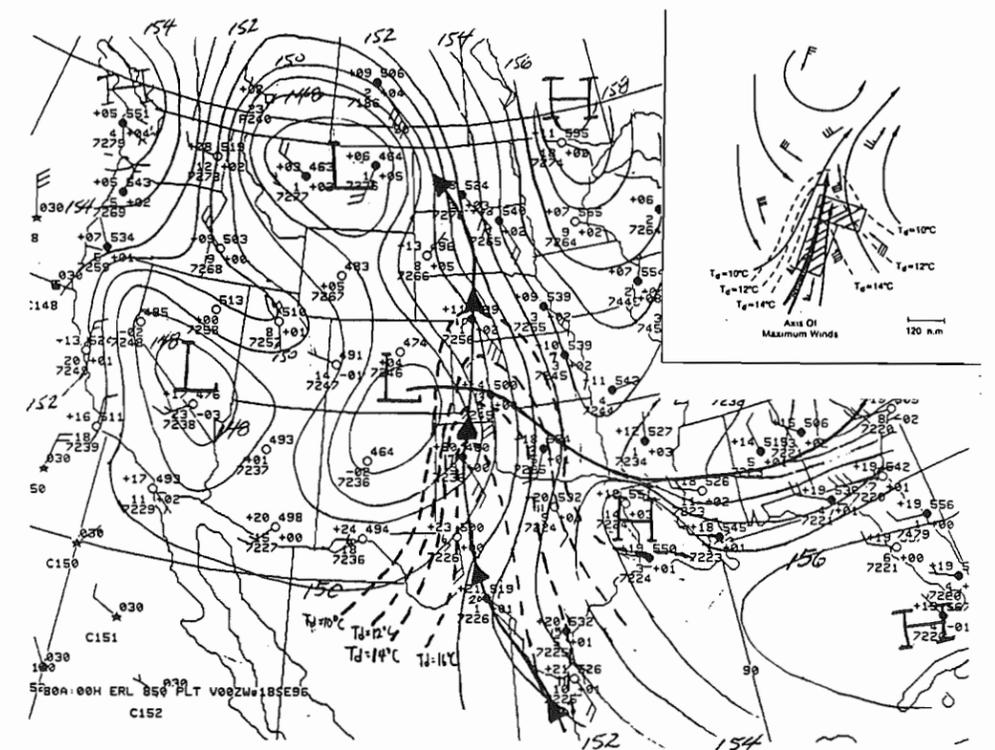


Fig. 5. Same as Fig. 4, except 850 mb analysis.

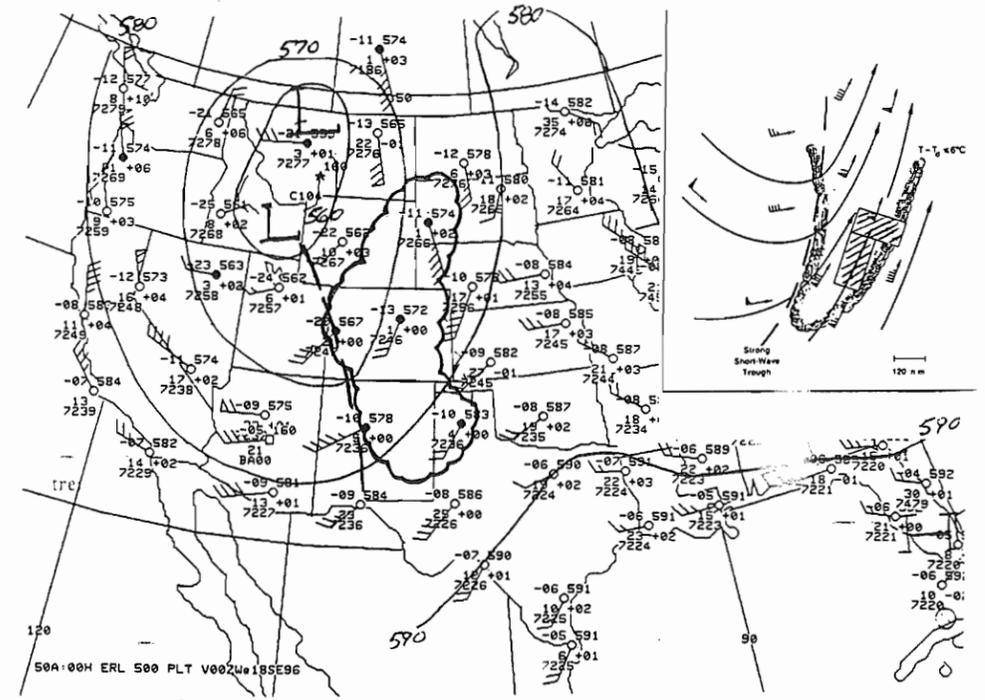


Fig. 6. Same as Fig. 4, except 500 mb analysis.

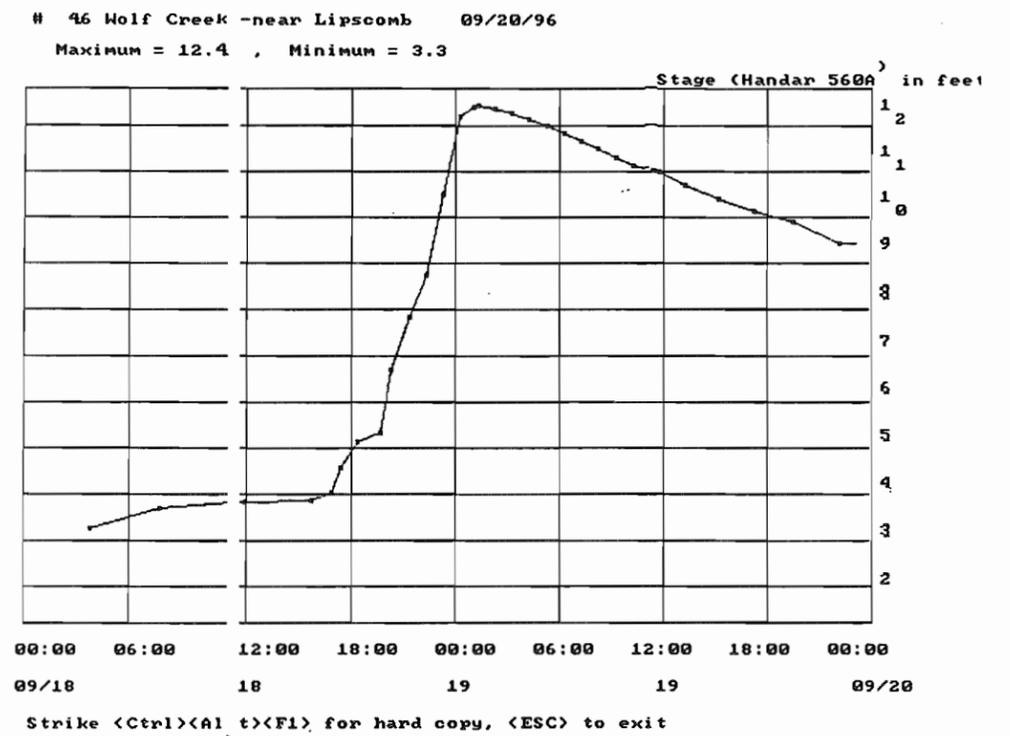


Fig. 7. River stages for Wolf Creek near Lipscomb.