Natural Disaster Survey Report

Wichita/Andover, Kansas, Tornado April 26, 1991

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service, Silver Spring, Maryland

Cover: Photograph of the Wichita/Andover tornado destroying the recreation facilities on McConnell Air Force Base. Photograph courtesy of A1C Daniel L. Studebaker.

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U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary

National Oceanic and Atmospheric Administration
Dr. John A. Knauss, Administrator

National Weather Service
Dr. Elbert W. Friday, Jr., Assistant Administrator

PREFACE

Tornadoes are one of the most destructive forces of nature. It is always a humbling experience to view the devastation first hand and a difficult experience to interview individuals that have lived through such a tragedy. Unfortunately, it is only through disasters such as these that the National Weather Service and the hazards community can fully assess its warning procedures and capabilities.

I would like to express my sincere gratitude to the Disaster Survey Team for their efforts in producing this unbiased survey report on the performance of the National Weather Service during this tragic event. Furthermore, I applaud the efforts of all those involved in the warning process, including the National Severe Storms Forecast Center, the Wichita Office of the National Weather Service, local spotter groups, law enforcement officials, emergency managers, and the local media. Without such stellar efforts to communicate the danger to the public, the results from this tornado would have been even more catastrophic.

Elbert W. Friday, Jr.

December 1991

FOREWORD

This survey report on the tornadoes which struck south-central Kansas on April 26, 1991, was prepared by a National Oceanic and Atmospheric Administration Disaster Survey Team following a 4-day visit to the storm site. The report is based upon information gathered by the team through a series of visits to National Weather Service offices and during interviews with members of other agencies; public utilities; organizations; state, county, and municipal governments; the broadcast and print media; and eyewitnesses. At the request of the survey team, an extensive aerial survey of the Wichita/Andover and Cowley County tornadoes was conducted by Brian Smith from the National Severe Storms Forecast Center.

The team thanks the county and municipal officials, including the Mayor of Andover, the Mayor of Haysville, and numerous other officials from Butler, Cowley, and Sedgwick Counties, who took time from their urgent disaster response duties to share their impressions of the event and interpretations of the effectiveness of National Weather Service watch and warning products. The team also thanks Major Mike Hunsucker and the shift meteorologists of the McConnell Air Force Base Weather Detachment for their detailed and timely briefings on the tornado event at the base. Special thanks go to the Kansas Highway Patrol for their loan of a plane and pilot in support of the aerial survey. Thanks are also due to National Environmental Satellite, Data, and Information Service for supplying satellite interpretation and images used in this report.

This document is not intended to chronicle the entire history of the tornado-producing thunderstorm system. It does assess the effectiveness of National Weather Service performance and products before and during the tornadoes in south-central Kansas. The report presents a number of findings, followed by related recommendations, based upon the team's survey. The recommendations could lead to more effective severe storm and tornado warning and forecasting procedures in south-central Kansas.

Strong thunderstorms and associated tornadoes also raged across northern Oklahoma on April 26. Although this report does not formally examine those storms, it does address certain information regarding that event. In particular, the performance of the Weather Surveillance Radar 1988 Doppler (WSR-88D) in operation at the Weather Service Forecast Office in Norman, Oklahoma, is contrasted with equipment and techniques in use in the Wichita, Kansas, area. The WSR-88D system was not utilized in support of warnings or forecasts of the thunderstorm system which produced the Wichita area tornadoes.

The Disaster Survey Team

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ACRONYMS

AFOS	Automation of Field Operations and Services
AO	Areal Outline
ASTRA	Automated Statewide Telecommunications Records Access
CDT	Central Daylight Time
CPCS-1	Central Program Control Station
CREST	Citizens Radio Emergency Services Team
CWA	County Warning Area
dBZe	Equivalent Reflectivity
EBS	Emergency Broadcast System
EMC	Emergency Management Community
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
KHP	Kansas Highway Patrol
km	Kilometer
LI	Lifted Index
mb	Millibar
MCS	Mesoscale Convective System
MHz	Megahertz
MIC	Meteorologist in Charge
m/s	Meters per second
NAWAS	National Warning System
NC	National Centers
NESDIS	National Environmental, Satellite, Data, and Information Service
NEXRAD	Next Generation Radar
NGM	Nested Grid Model
nm	Nautical Mile
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NSSFC	National Severe Storms Forecast Center
NWR	NOAA Weather Radio
NWS	National Weather Service
NWWS	NOAA Weather Wire Service
PC	Personal Computer
PWO	Public Severe Weather Outlook
RACES	Radio Amateur Civil Emergency Service
RPPI	Remote Plan Position Indicator
SFD	State Forecast Discussion
SLS	Severe Local Storms
SPS	Special Weather Statement

SSTO	State Severe Thunderstorm Outlook
SVS	Severe Weather Statement
SWIS	Satellite Weather Information System
TWC	The Weather Channel
UTC	Coordinated Universal Time
VAS	VISSR Atmospheric Sounder
VDUC	VAS Data Utilization Center
VISSR	Visible and Infrared Spin Scan Radiometer
WFO	Weather Forecast Office
WRSAME	NWR Specific Area Message Encoder
WSFO	Weather Service Forecast Office
WSO	Weather Service Office
WSOM	Weather Service Operations Manual
WSR-57	Weather Surveillance Radar 1957
WSR-88D	Weather Surveillance Radar 1988 Doppler
ZFP	Zone Forecast Product

THE WICHITA/ANDOVER TORNADO DISASTER SURVEY TEAM

Following a major severe weather event in which there has been extensive damage or loss of life, a disaster survey team may be assigned by the National Oceanic and Atmospheric Administration (NOAA) to evaluate the role played by the National Weather Service (NWS), to provide an objective appraisal of the services, and to make findings and recommendations for improving the service. Such a team was assembled to survey the Wichita/Andover, Kansas, tornado which struck south-central Kansas on April 26, 1991.

Team Members

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EXECUTIVE SUMMARY

Early in the evening of April 26, 1991, a strong tornado tracked through the south and east suburbs of Wichita, Kansas. The synoptic weather situation that occurred was typical of a springtime pattern in the central United States. Many tornadoes touched down that day from Nebraska to Texas, but the most devastating twister tracked just south of Wichita and flattened the Golden Spur Mobile Home Park in Andover, Kansas, a town east of Wichita in Butler County.

The Wichita/Andover tornado was spawned by a supercell thunderstorm that moved northeastward from northern Oklahoma into south-central Kansas. This thunderstorm produced four separate tornadoes along its path. The third and strongest tornado caused tremendous damage and destruction in Sedgwick and Butler Counties. This tornado reached an intensity of F5, the highest rating on the Fujita Tornado Intensity Scale, and was on the ground for approximately 46 miles from about 20 miles southwest of Wichita, near Clearwater, to 10 miles northeast of Wichita, near El Dorado.

Farther south and east, a different supercell thunderstorm produced other violent tornadoes that moved through Cowley, Elk, Greenwood, and Woodson Counties. These twisters moved through mostly rural areas so damage totals were much less severe than from the Wichita/Andover tornado.

Thirteen of the 19 deaths in Kansas occurred in the Golden Spur Mobile Home Park. The deaths in Elk and Cowley Counties were in mobile homes. A total of 298 injuries were reported. The devastation left by these tornadoes exemplifies the danger of remaining in a mobile home during a tornado. Sedgwick and Butler Counties were hardest hit by the tornadoes that affected south-central Kansas. At the time of this report, total damage estimates from all the tornadoes that affected south-central Kansas exceed $272 million, including approximately $62 million damage at McConnell Air Force Base. A total of 1,728 homes were damaged or destroyed by the tornadoes, including the destruction of most of the 241 mobile homes in the Golden Spur Mobile Home Park in Andover.

The NWS did an excellent job warning and forecasting for the severe weather and tornadoes that stormed across Kansas on April 26. The tornado watch issued by the National Severe Storms Forecast Center (NSSFC) in Kansas City, Missouri, provided nearly 6 hours of lead time before the killer tornadoes first touched down. Warning services provided by the Wichita, Kansas, Weather Service Office (WSO) supplied accurate and timely information to the public and emergency management community enabling them to take suitable actions.

The warnings issued by the Wichita office were exceptionally well written and contained appropriate call to action statements that effectively communicated the urgency of the situation. The majority of the warnings provided ample lead time for proper safety actions to be taken. The warning covering western Butler County explicitly mentioned Andover and provided a 7-minute lead time before the tornado devastated the mobile home park. The lead time provided by the NWS warning enabled the local police department to compensate for a failed local warning siren in Andover. Patrol cars drove through the town sounding their sirens to alert people to a potential threat. One patrolman drove his car, with siren sounding, through the mobile home park that was literally leveled just minutes later.

As the storm neared Wichita, it became masked by the ground clutter pattern of the NWS network radar (Weather Surveillance Radar 1957 [WSR-57]) making it virtually impossible to detect and identify tornadic signatures in the radar data. This made spotter reports the primary source of tornado information for WSO Wichita.

WSO Wichita has an active internal and external preparedness program. During the past year, the meteorologist in charge (MIC) at the Wichita office conducted spotter training and/or preparedness meetings in all of the 22 counties within the WSO Wichita area of warning responsibility. On April 26, the spotter training proved invaluable. All of the tornado warnings issued by the Wichita office were based on spotter reports.

Strong thunderstorms also raged across northern Oklahoma on April 26. The Weather Surveillance Radar 1988 Doppler (WSR-88D) in operation at the Weather Service Forecast Office (WSFO) in Norman, Oklahoma, enabled forecasters to see signatures of a developing tornado within the structure of the thunderstorm before spotters reported any visual precursor indications of a developing tornado. Because of the WSR-88D, WSFO Norman was able to issue a tornado warning 24 minutes before one twister touched down. The experiences at both Wichita and Norman illustrate the importance of both the spotter networks and the Doppler radar technology in the detection and warning processes of the NWS.

The tornado warnings issued by the Wichita office were disseminated statewide to the emergency management community predominantly by the Automated Statewide Telecommunications Records Access (ASTRA) Law Enforcement Communications Circuit which uses NWS warnings transmitted on the NOAA Weather Wire Service (NWWS). Warnings were also disseminated on the NOAA Weather Radio (NWR) but reached a much smaller audience.

The local media played a vital role in alerting the public to the impending danger by relaying NWS warnings. There is a close working relationship between the media and WSO Wichita. This close working relationship allowed the hazards community

to speak with one voice. The public heard the same message from different sources that confirmed the danger and convinced people to take action.

The tornado struck in the early evening when most people were home preparing for dinner or watching television. Because of this, the warning messages reached a large percentage of the population at risk. Most people that were interviewed heard the tornado warning on radio or television and then went to "assess their own risk" by looking outside to see the tornado. Only then did they take correct safety action. The extensive preparedness efforts by the hazards community in the Wichita area paid off. People knew the proper safety rules and took action.

Aerial view of the Golden Spur Mobile Home Park. Photograph courtesy of Brian Smith, NSSFC.

Photograph of F5 damage area west of the Golden Spur Mobile Home Park in Andover, Kansas. The tornado moved from left to right across the picture. Notice how the debris from the destroyed homes blew toward the mobile home park. Photograph courtesy of Paul Bowen.

CHAPTER 1

DESCRIPTION AND IMPACT OF THE EVENT

Early in the evening of April 26, 1991, a violent tornado tracked through the south and east suburbs of Wichita, Kansas. The synoptic weather situation that occurred was typical of a springtime pattern in the central United States. Numerous severe thunderstorms occurred throughout the central states from Texas to Nebraska. There were 203 reports of severe weather, including 113 reports of large hail and 56 tornadoes (see appendix A for the list of severe weather reports). In south-central Kansas alone there were numerous confirmed tornadoes, one of which was on the ground for 46 miles. It was this long track tornado that caused most of the damage and deaths in south-central Kansas.

The Wichita/Andover tornado was one of a family of four tornadoes spawned by a thunderstorm with supercell characteristics that developed over north-central Oklahoma and moved northeast across south-central Kansas (figure 1). A supercell is a strong thunderstorm that contains a deep, persistent rotation within the updraft. The first twister briefly touched down just after 5 p.m., Central Daylight Time (CDT),[1] near the city of Anthony in Harper County. The second tornado formed approximately 40 miles southwest of Wichita in Harper County between the cities of Danville and Freeport about 5:20 p.m. This vortex lifted southwest of Conway Springs in Sumner County.

The third tornado spawned by the supercell developed into the devastating tornado that caused most of the damage and deaths in Kansas (figure 2). At the request of the survey team, an NSSFC meteorologist trained in aerial damage survey techniques conducted an aerial damage survey to examine the track of this third tornado. The Kansas Highway Patrol (KHP) provided use of one of their pilots and aircraft to perform the survey. The aerial survey was conducted on May 1, 5 days after the tornado struck. By that time, much of the damage had been removed, and it was difficult to assess the intensity of the tornado. Fortunately, aerial photographs that had been taken the day after the storm were obtained for analysis. It was determined from these pictures that the tornado reached an F5 on the Fujita Tornado Intensity Scale (appendix B) as it moved through Andover. A detailed aerial survey report is included in appendix C. A

[1] All times in the report are in Central Daylight Time unless otherwise noted.

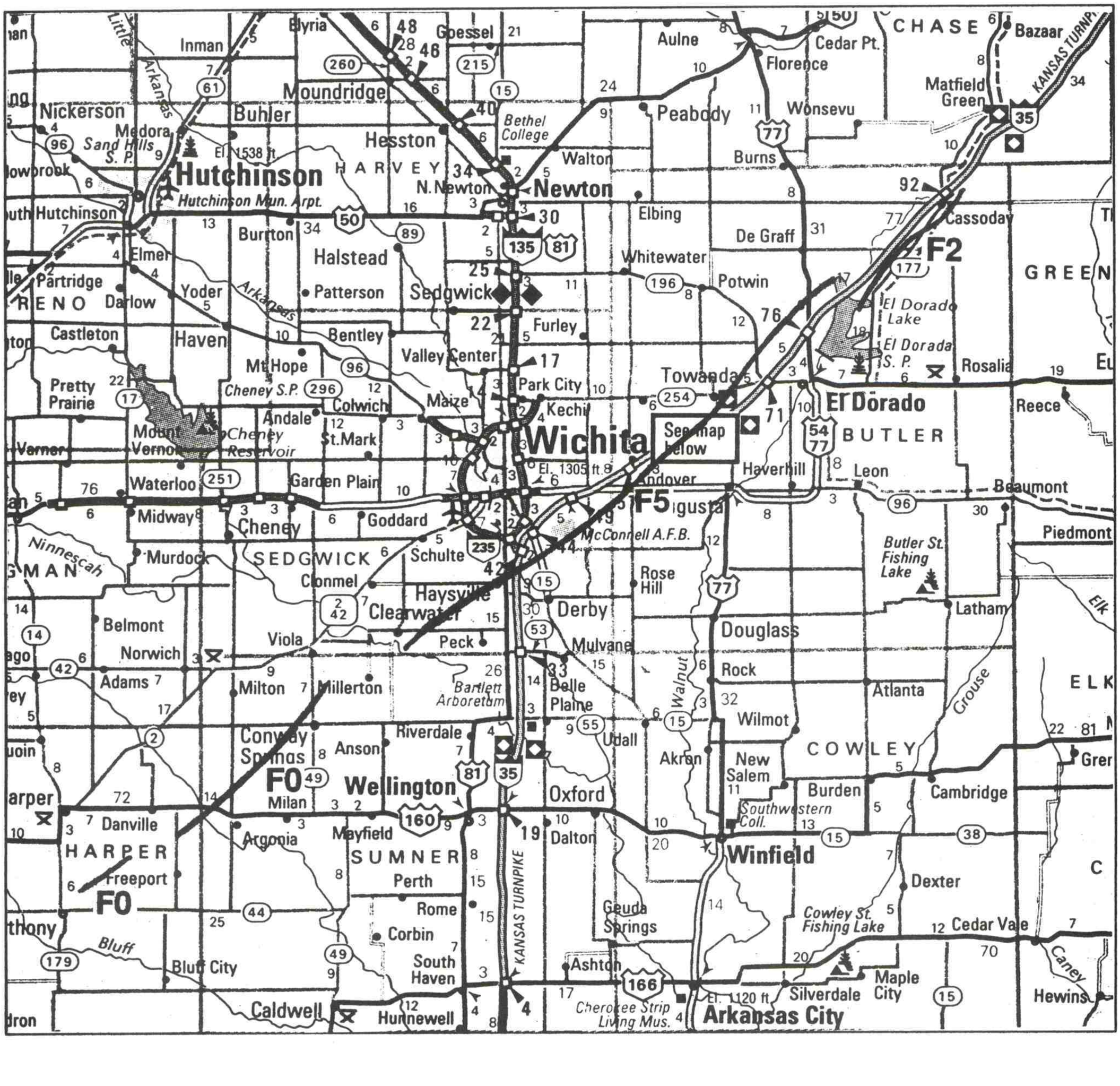


Figure 1. Tracks of tornadoes produced by the supercell which spawned the Wichita/ Andover tornado.

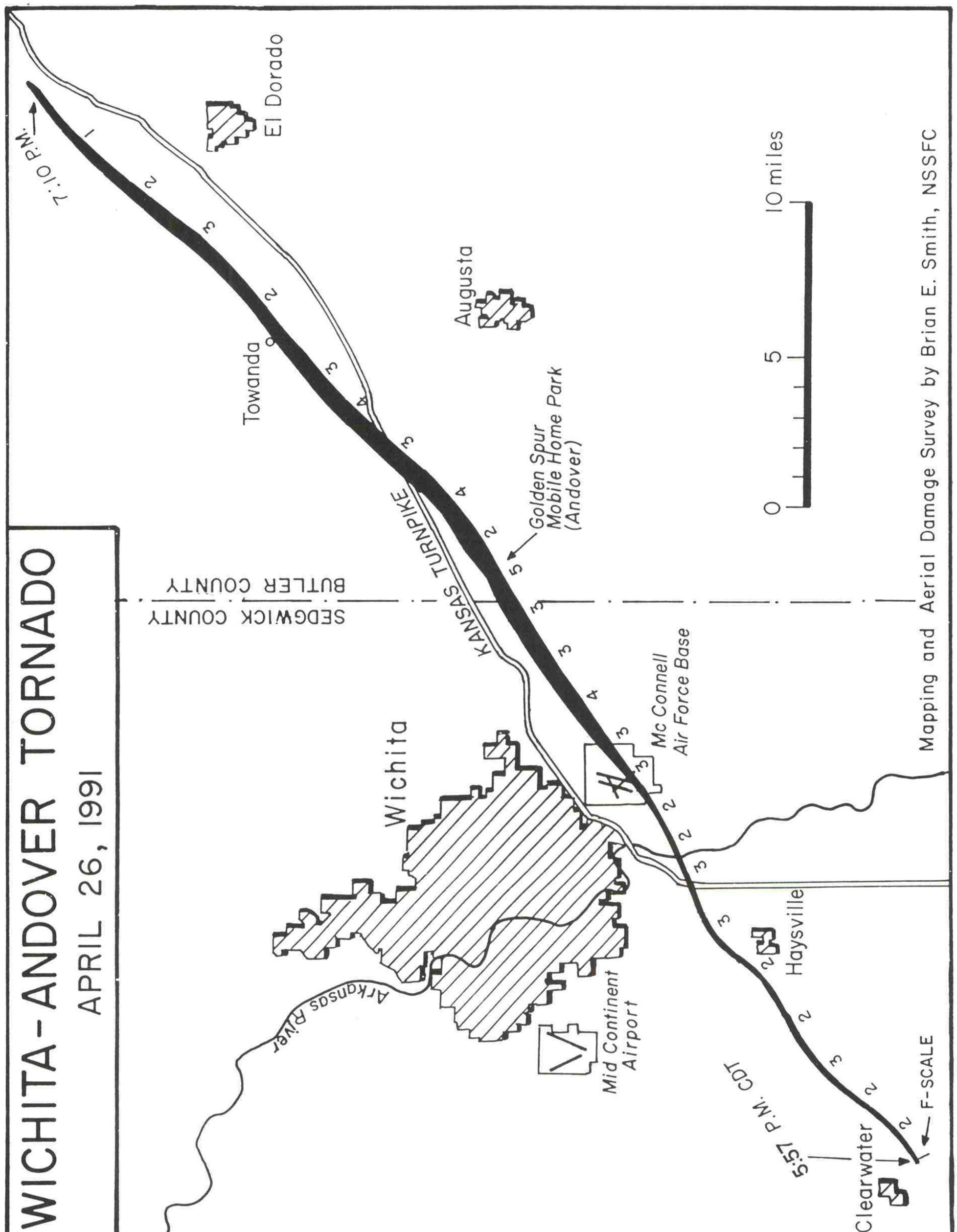


Figure 2. Track of the Wichita/Andover tornado.

brief aerial survey was also conducted for the Cowley County tornado.

The third tornado, the Wichita/Andover tornado, touched down at approximately 5:57 p.m. in Sedgwick County, 1 1/2 miles south-southeast of Clearwater, Kansas, and moved northeast through Haysville by 6:18 p.m. The tornado continued moving northeast and maintained between an F2 and F3 intensity on the Fujita scale and a path width of 200 to 300 feet as it crossed McConnell Air Force Base, just southeast of Wichita. The twister reached the Air Force Base by 6:25 p.m. and caused extensive damage to structures on the base. The tornado narrowly missed several parked B1-B bombers as it passed 1,000 feet south of the flight line.

This tornado continued tracking northeastward and expanded its path width to between 500 and 600 feet. The tornado strengthened to an F4 intensity and inflicted devastating damage to the Greenwich Heights subdivision. Continuing on its northeast track, the tornado headed toward the city of Andover in Butler County. It was along this path that the tornado inflicted incredible damage and destruction. The tornado strengthened to F5 intensity and flattened homes in a subdivision just west of the Golden Spur Mobile Home Park. Data from the Kansas Gas and Electric Company indicated that the tornado struck the mobile home park at 6:40 p.m. The park sustained catastrophic damage from the tornado. Many homes and businesses were severely damaged or destroyed by the tornado along the path from Haysville to northeast of Andover.

The killer tornado finally began to weaken as it moved northwest of El Dorado and dissipated approximately 5 miles north of El Dorado. A fourth tornado spawned by the supercell formed over El Dorado Lake and moved northeast toward Cassoday. This tornado lifted northeast of Cassoday and was on the ground for about 15 to 20 miles, reaching F2 intensity on the Fujita scale.

The supercell that spawned the killer Wichita/Andover tornado was the northern most member of a group of four supercells that tracked across south-central Kansas and Oklahoma. Another rotating thunderstorm produced tornadoes that affected Cowley, Elk, Greenwood, and Woodson Counties (figures 3a and 3b). Eyewitness accounts from county sheriff's offices indicated that these tornadoes tracked in a discontinuous path across the four counties. One tornado reached at least an F4 intensity and caused one death near Winfield in Cowley County with another tornado-related death occurring in Elk County. Fortunately, these tornadoes tracked through rural areas so damage was minimal.

Fifteen of the 19 deaths in Kansas occurred in or around mobile homes. The remaining four deaths occurred in the Greenwich Heights subdivision. These individuals are believed to have been caught outside while seeking more sturdy shelter, presumably a home with a basement. Seventeen

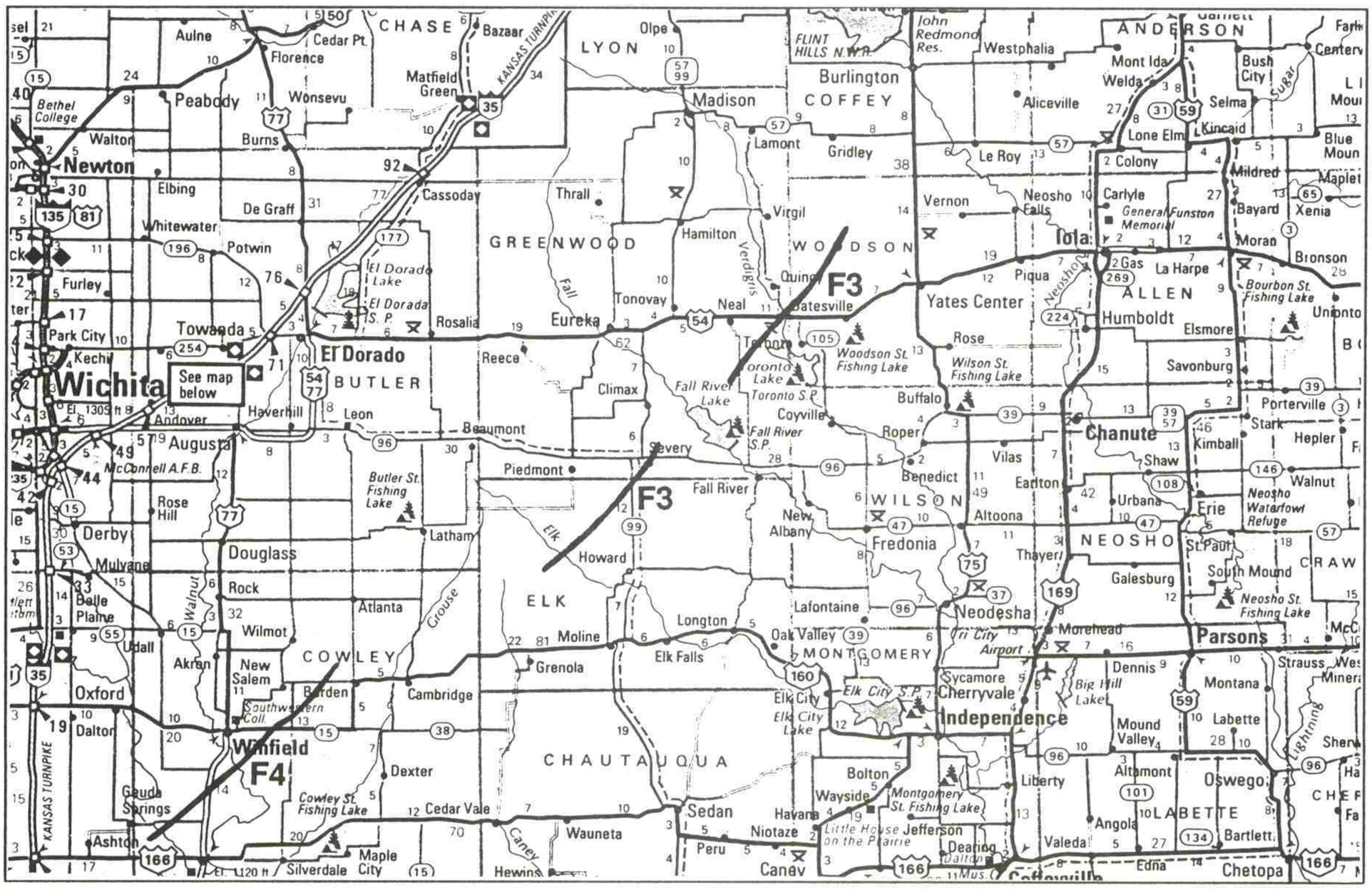


Figure 3a. Tornado tracks across Cowley, Elk, Greenwood, and Woodson Counties.

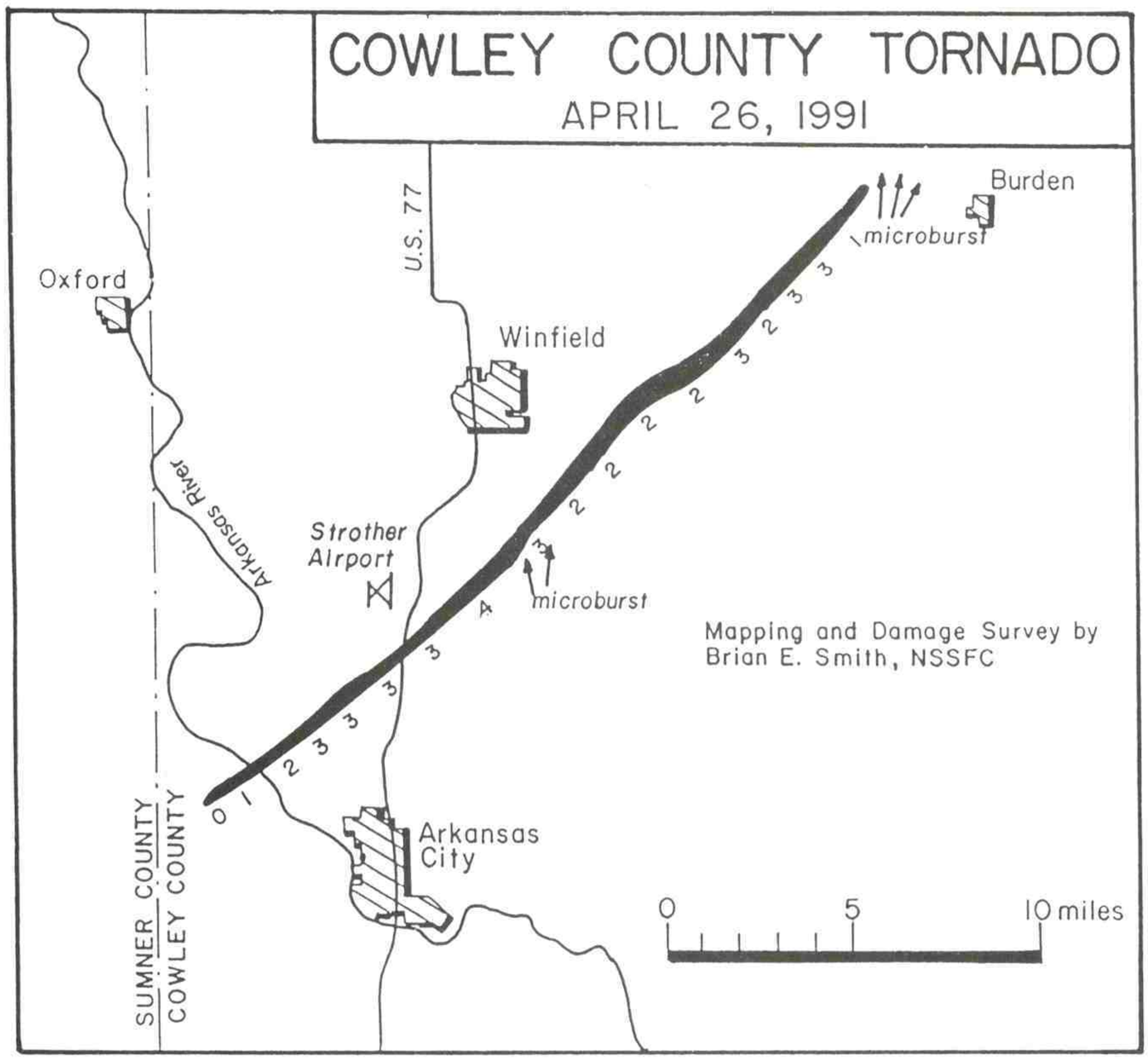


Figure 3b. Path of the tornado across Cowley County.

deaths are attributed to the Wichita/ Andover tornado with 13 in the city of Andover, all in the Golden Spur Mobile Home Park. Most of the deaths were elderly people with the average age of 65. A total of 298 injuries were reported in south-central Kansas.

According to damage statistics provided by the Federal Emergency Management Agency (FEMA), total damage estimates from all the tornadoes which affected south-central Kansas exceed $272 million, including approximately $62 million to McConnell Air Force Base. A total of 1,728 homes were damaged or destroyed by the Wichita/Andover tornado, including the destruction of most of the 241 mobile homes in the Golden Spur Mobile Home Park in Andover. Of the counties in south-central Kansas hit by the tornadoes, Sedgwick and Butler Counties sustained the most damage.

On April 28, Kansas Governor Joan Finney requested that Sedgwick and Butler Counties be declared a major disaster by the President. On Monday, April 29, President George Bush declared a major disaster in the State of Kansas. Butler and Sedgwick Counties, and later Cowley County, were declared eligible for public assistance programs.

Finding 1.1: The Wichita/Andover tornado was one of four tornadoes spawned from a supercell that tracked from north-central Oklahoma across south-central Kansas into eastern Kansas before weakening. There were other strong tornadoes in Kansas and Oklahoma from different thunderstorms, but these tornadoes tracked mostly across rural areas.

Finding 1.2a: An NSSFC meteorologist trained in aerial damage survey techniques conducted an aerial damage survey to examine the tornado track. The survey was conducted 5 days after the tornado, long after many of the areas had been cleaned up. Most of the destroyed homes and buildings were already removed making it difficult to ascertain the exact strength of the tornado. Fortunately, aerial photos were obtained that had been taken on the morning of April 27, the day after the storm. The damage in these pictures supported a tornado intensity rating of F5.

Finding 1.2b: The Wichita/Andover tornado was surveyed in detail and much important data has been obtained from the aerial survey. However, the opportunity to gather more tornado research data covering the remainder of this multiple state tornado outbreak was lost. The Operational Support Facility in Norman would also have greatly benefited from an aerial survey of the entire outbreak over Oklahoma.

Recommendation 1.2: Establish the capability to conduct quick response aerial and ground surveys after all significant (F4 or F5) tornadic events. Surveys are necessary whenever there is severe damage or significant loss of life resulting from significant tornadic events. Timely tornado surveys are also needed to obtain data for tornado research and Storm Data. Detailed analyses of aerial data will provide invaluable information as the results are compared to what is observed in the WSR-88D velocity data, reflectivity data, and all derived products.

CHAPTER 2

METEOROLOGICAL SETTING

The meteorological conditions over the Central Plains on April 26 were extremely favorable for the development of strong thunderstorms and tornadoes. The meteorological pattern was a "classic" severe weather situation with a strong middle level (500 millibar [mb]) trough of low pressure combined with favorable jet stream winds and integral strong low-level boundaries to form and enhance the thunderstorms.

The prevalent long wave, middle level (500 mb) pattern that had persisted for most of April consisted of a large low pressure system anchored over the Gulf of Alaska and a ridge of higher pressure over the central and eastern United States. The pattern began changing during the week before April 26 as a series of low pressure systems migrated from the Gulf of Alaska upper level low into the western United States. The middle level low pressure system responsible for the April 26 outbreak moved into the Pacific Northwest the morning of April 25 (figure 4). A strong flow of northwest winds on the backside of the upper level low resulted in a northwest-southeast tilt, or negative tilt, of the low pressure trough that extended southward into southwestern Arizona.

Jet stream winds in excess of 110 knots on the west side of the system caused the trough of low pressure to move southeastward into south-eastern Utah by the morning of April 26 (figure 5). Even though the strongest jet stream winds remained on the west side of the system, the leading edge of the maximum winds had rounded the base of the trough and had turned northward (figure 6).

The tornado outbreak of April 26 was typical of major outbreaks as several synoptic scale and mesoscale features combined to produce the extensive severe weather. At 1300 UTC (Coordinated Universal Time) on April 26, a surface low pressure system was located in southwestern Nebraska (figure 7) with a dry line extending southward into west Texas. Dew points in the lower to middle 60s covered much of Oklahoma and Kansas, while dew points lowered into the 20s behind the dry line. A warm front extended from the low in Nebraska south-eastward through Kansas and into extreme northeastern Oklahoma. During the morning, the dry line moved rapidly eastward into western Oklahoma and central Kansas but slowed its eastward progression considerably during the afternoon. Normally, the dry line moves eastward as dry westerly winds erode the low level moisture and the air mass warms from daytime heating. The winds behind the dry line were westerly in the morning but backed to the south and southwest during the afternoon.

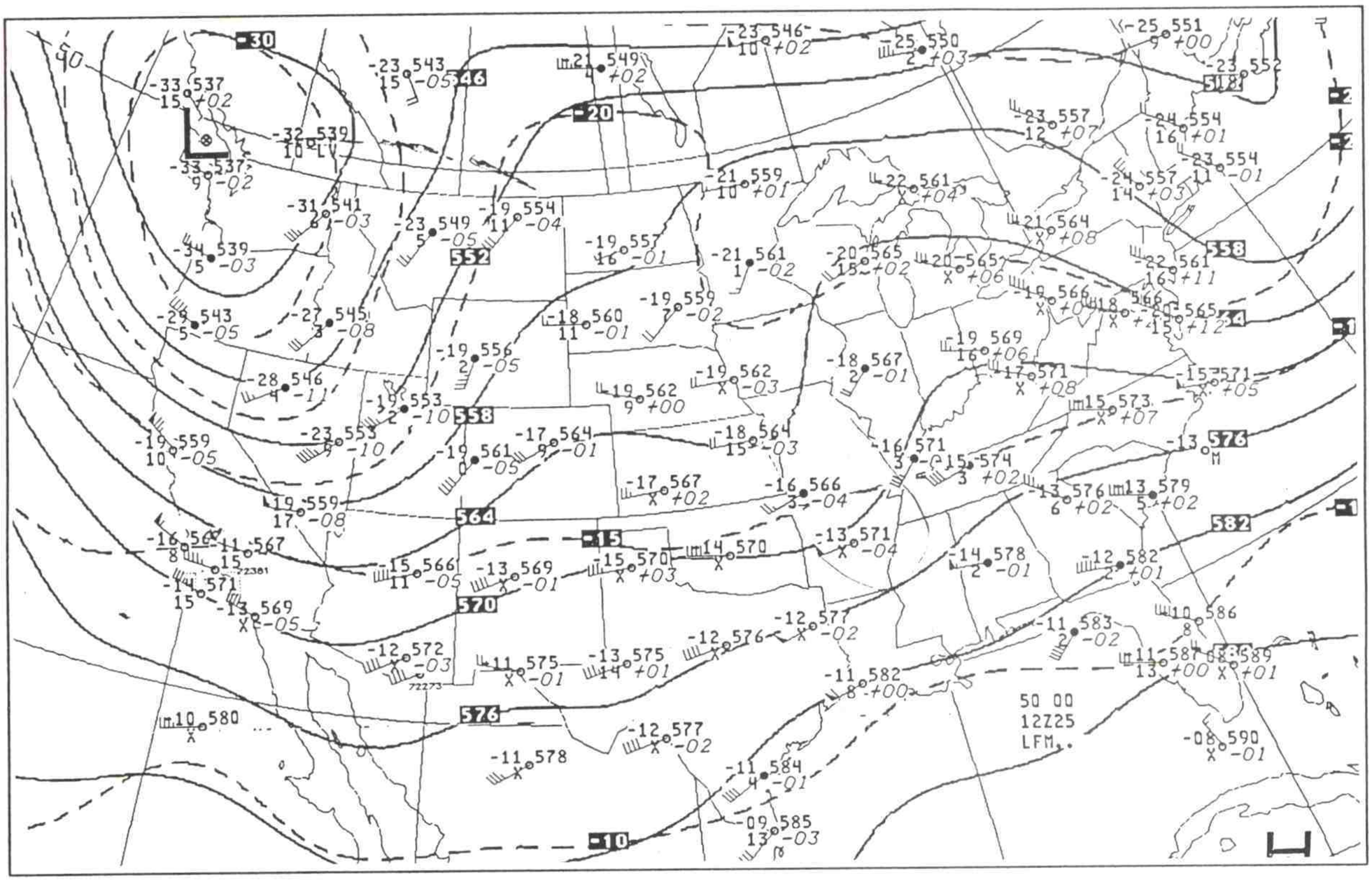


Figure 4. 500 mb analysis for April 25, 1991, 1200 UTC.

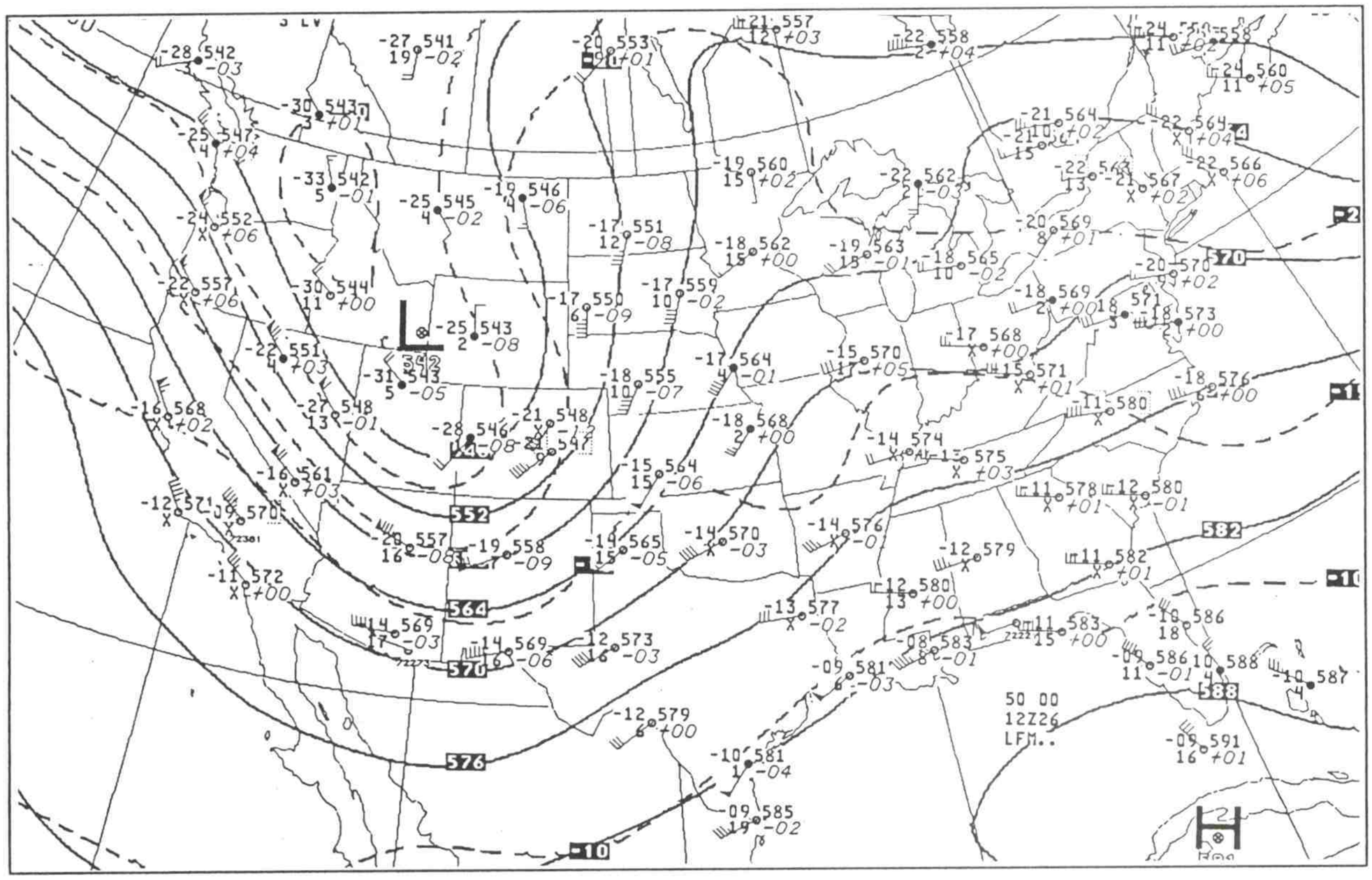


Figure 5. 500 mb analysis for April 26, 1991, 1200 UTC.

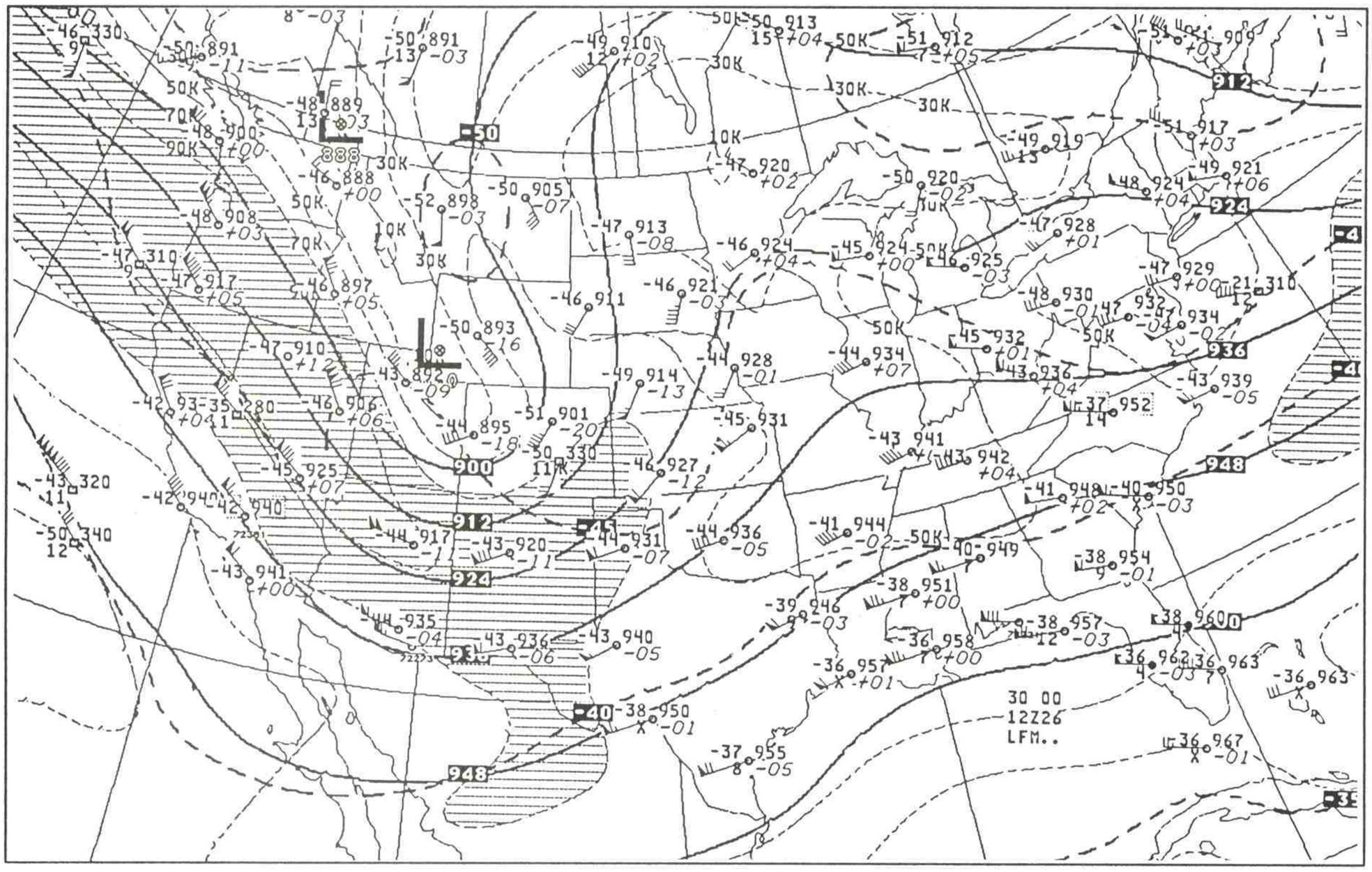


Figure 6. 300 mb analysis for April 26, 1991, 1200 UTC.

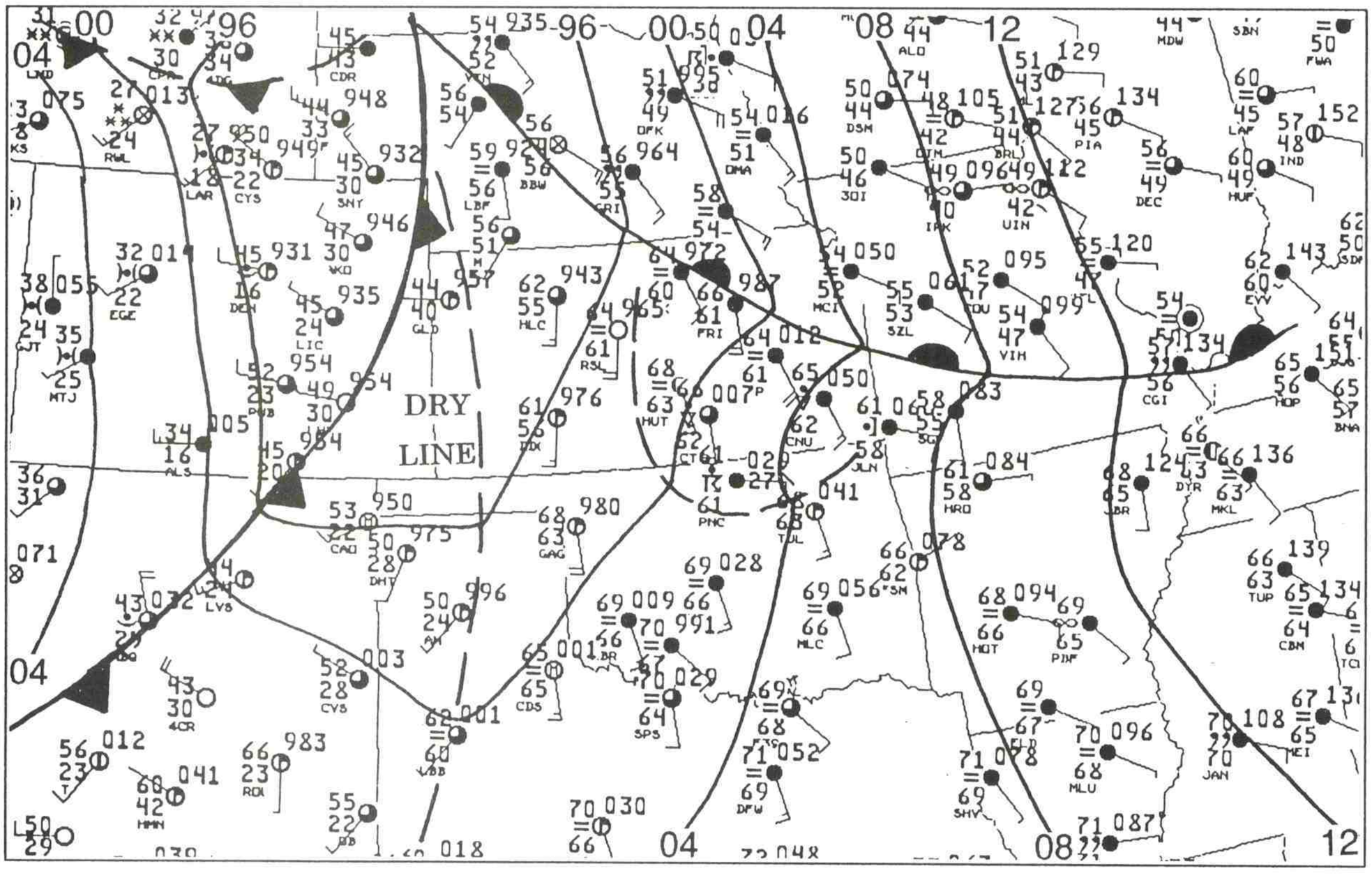


Figure 7. Surface analysis for April 26, 1991, 1300 UTC.

This change in wind direction behind the dry line slowed the eastward movement of the dry line during the afternoon.

A low-level (850 mb) jet of 35 to 50 knots was evident on the 26/1200 UTC data (figure 8) and extended from south-central Kansas northward into central North Dakota. The moist air, 10° Celsius or greater dew points, extended from southwestern Texas into central Kansas. Drier air in western Texas and southwestern Kansas was beginning to push east and northeast on the heels of brisk west to southwest winds. A jet maximum of 40 to 50 knots at 700 mb also stretched from the Texas Panhandle into central North Dakota (figure 9) and was advecting drier air into this layer of the atmosphere. By this time, a 500 mb short wave trough had rotated to the base of the negatively tilted long wave trough (figure 5).

The atmosphere over the central United States was extremely unstable with a strongly sheared environment. Sounding-based stability indices indicated very unstable conditions and supported severe thunderstorm development. For example, 26/1200 UTC surface-based lifted index values (LI) ranged from -5 to -7 (figure 10). Heat from the sun warmed the lower layers of the atmosphere and by afternoon, LIs reached -12 with the axis of greatest instability extending from central Oklahoma into central Kansas.

The 26/1200 UTC upper air sounding from Monet, Missouri, was missing as was the 850 mb wind from the Norman, Oklahoma, sounding. NSSFC used the wind information from the profiler station in Lamont, Oklahoma, to supplement the missing data. Profiler data was used throughout the day by NWS forecasters to assess how the atmospheric wind patterns were changing.

Vertical wind shear in the atmosphere is an important ingredient for tornadic development. Storm-relative helicity is used by NWS meteorologists to quantify this vertical wind shear. In particular, the measure of helicity in the lowest 3 kilometers of the atmosphere (3 kilometer [km] helicity) is used extensively. In general, 3 km helicity values below 300 m^2/s^2 (meters squared per second squared) correlate to weak tornadoes, values from 300 to 449 m^2/s^2 indicate the potential for strong tornadoes, and values 450 m^2/s^2 or greater are often associated with violent tornadoes. The 26/1200 UTC 3 km storm-relative helicity at Topeka was 313 m^2/s^2 (figure 11). By 27/0000 UTC, the 3 km storm relative helicity had increased to nearly 600 m^2/s^2 at the Lamont, Oklahoma, profiler site in northern Oklahoma. This increase was due to strengthening winds throughout the lower portions of the atmosphere.

On the morning of April 26, a large severe thunderstorm moved northeast-ward from north-central Oklahoma into southern Kansas. This storm combined with other thunderstorms to develop into a mesoscale convective system (MCS) as it moved across the southeastern third of Kansas, then weakened shortly after noon. This

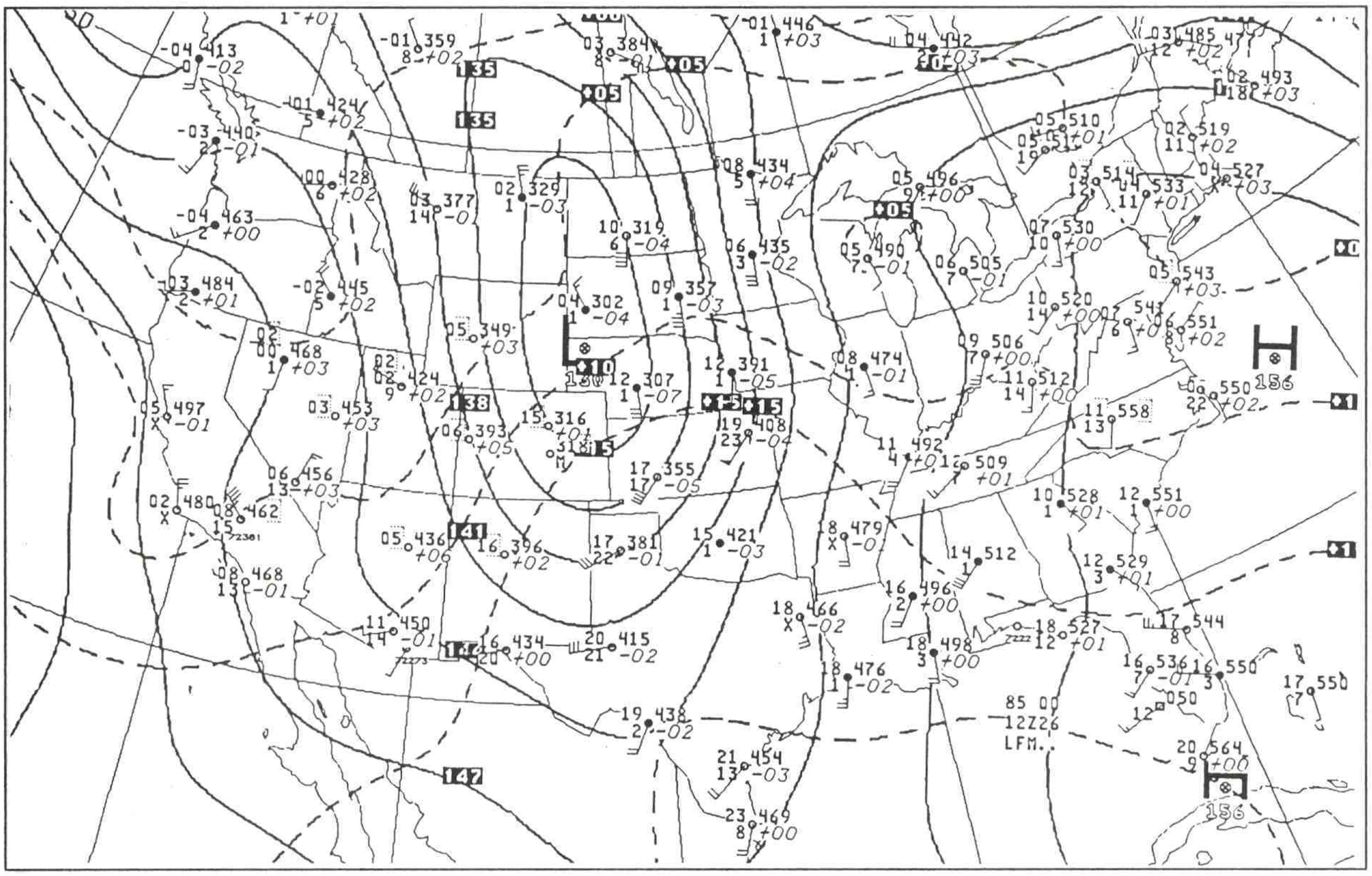


Figure 8. 850 mb analysis for April 26, 1991, 1200 UTC.

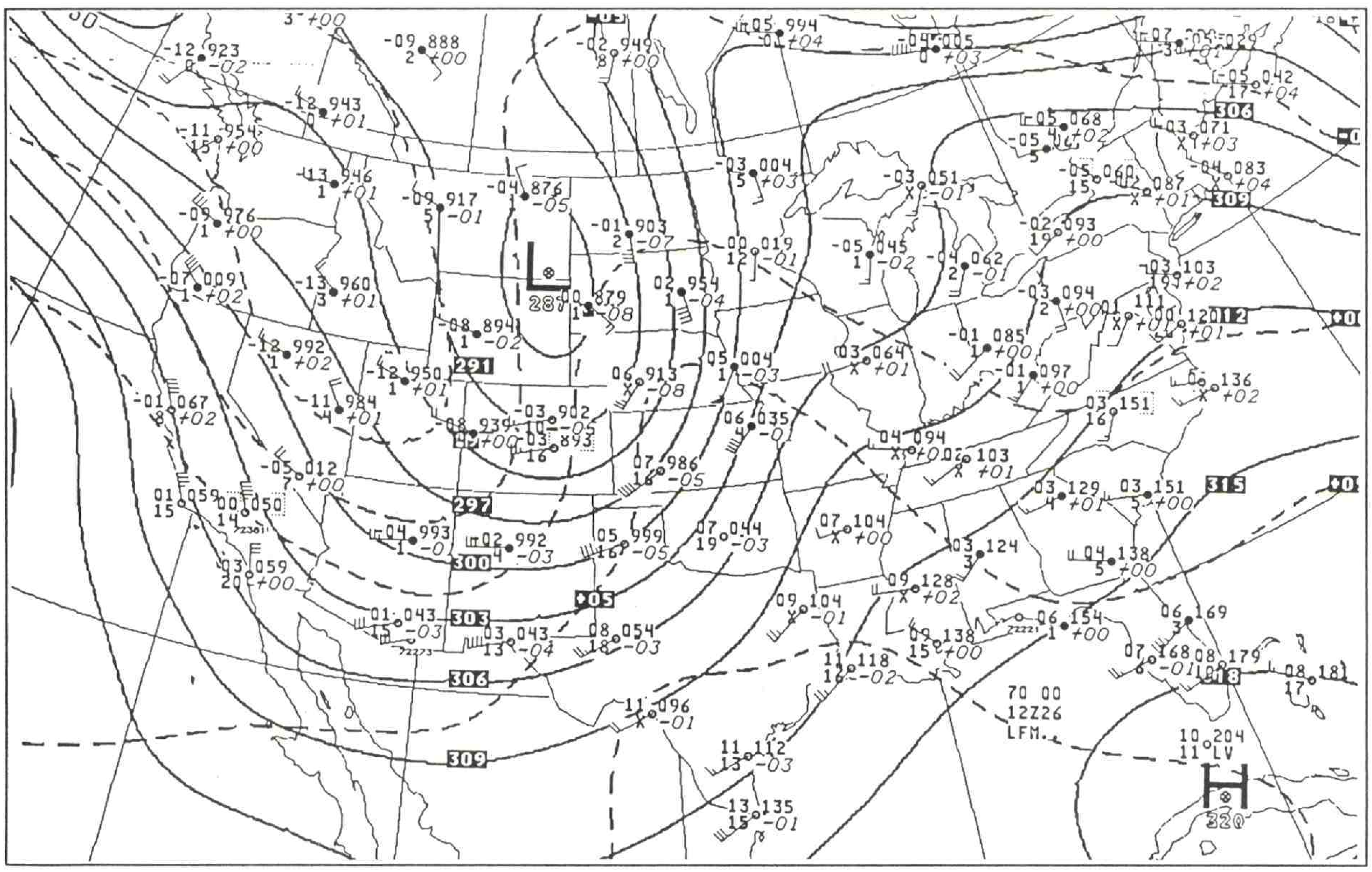


Figure 9. 700 mb analysis for April 26, 1991, 1200 UTC.

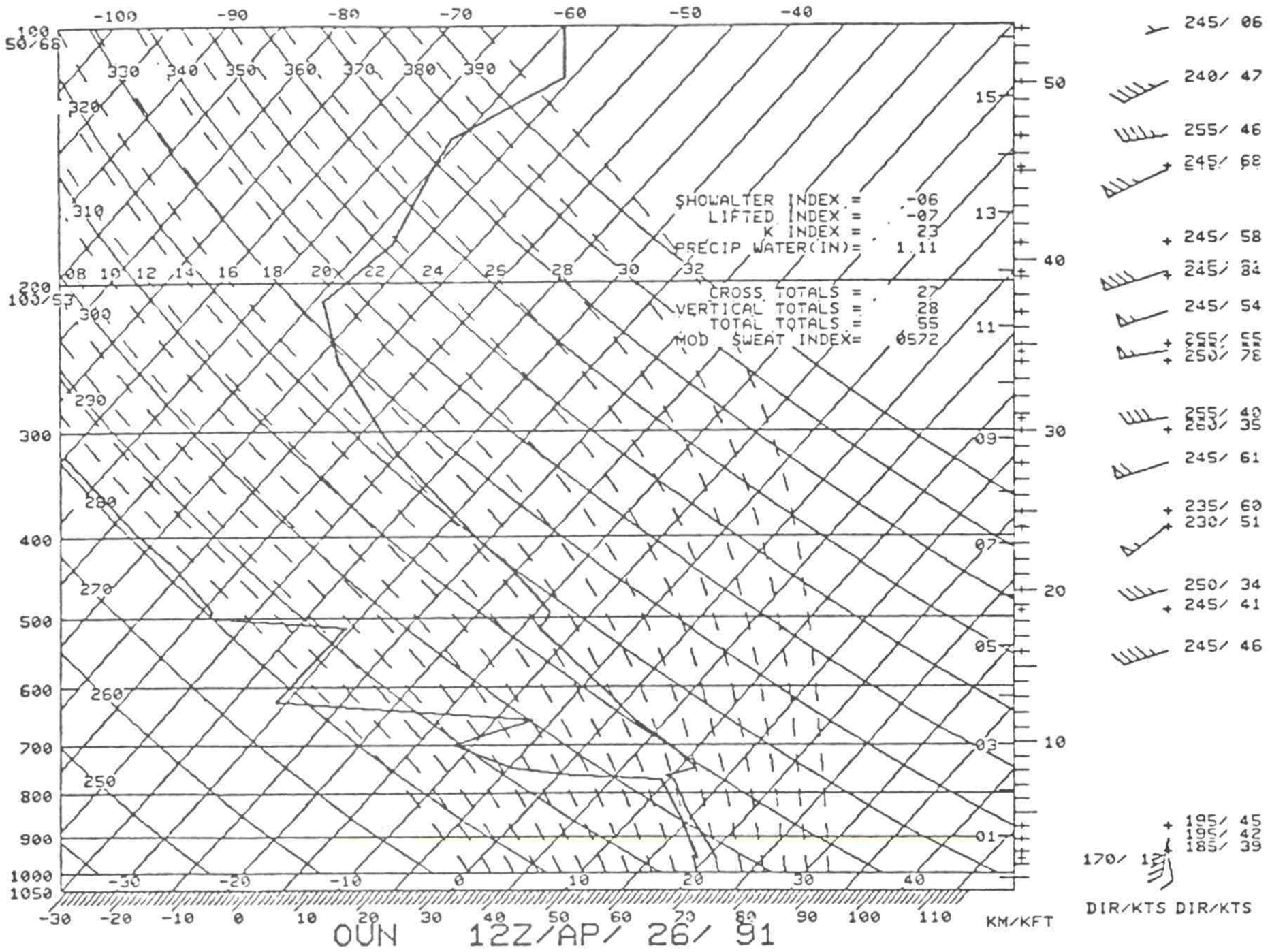


Figure 10. Upper air sounding from Norman, Oklahoma, April 26, 1991, 1200 UTC.

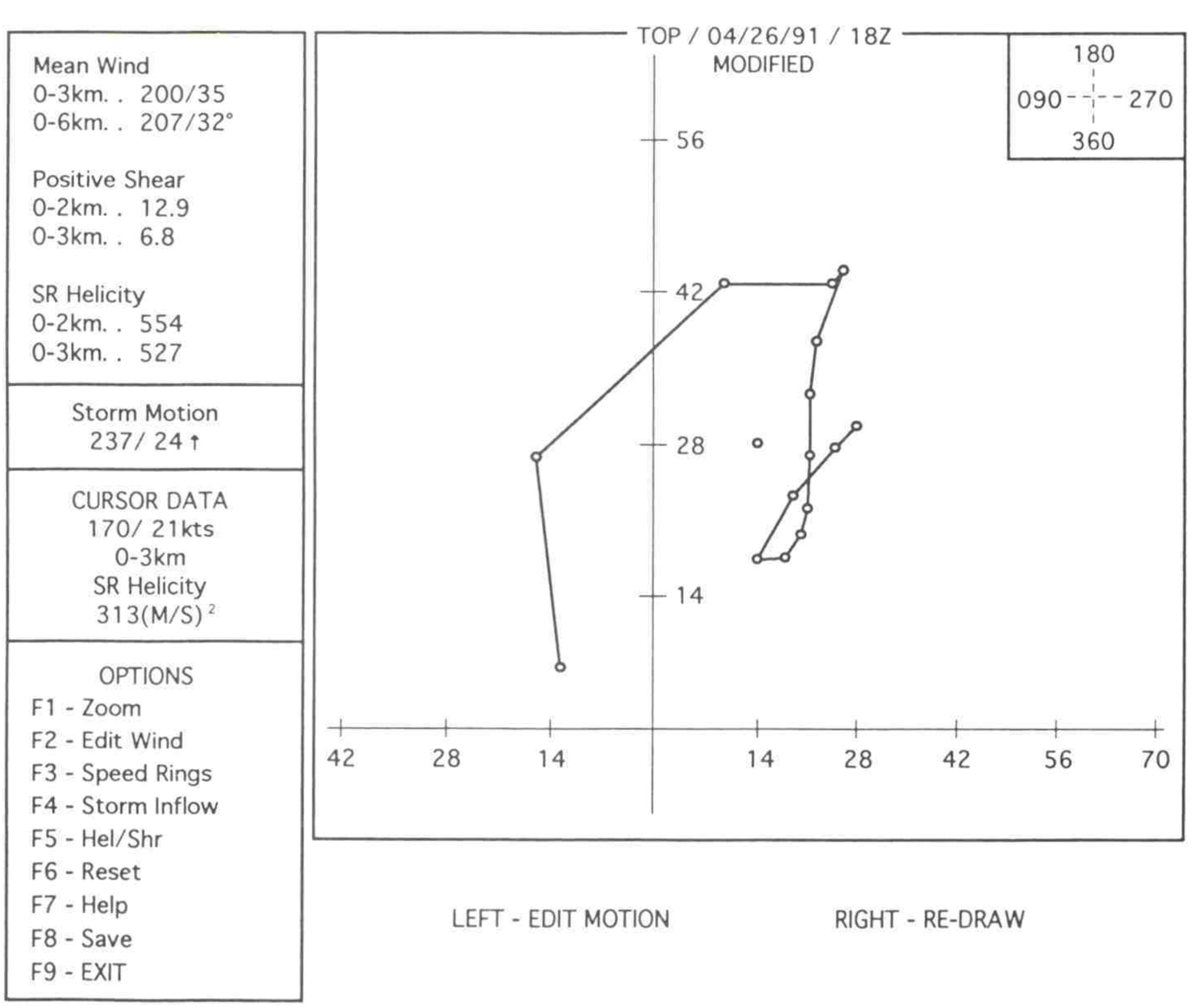


Figure 11. Hodograph for Topeka, Kansas, April 26, 1991, 1200 UTC.

MCS reinforced the cool air north of the warm frontal boundary. This boundary of rain cooled air remained nearly stationary through the afternoon from northwest of Wichita, Kansas, to south of Joplin, Missouri. Thunderstorms formed mainly on the dry line but became tornadic during the late afternoon and evening of April 26 as they approached the outflow boundary/warm front lying across south-central Kansas. By 26/2300 UTC (6 p.m.), the surface analysis indicated that the dry line had pushed eastward into central Kansas and Oklahoma (figure 12).

At 27/0000 UTC, the axis of warmest 850 mb temperatures extended from western Texas into western Kansas, east of Dodge City (figure 13). The moist axis was located across central Oklahoma and eastern Kansas, just east of the warm air. The 850 mb dew points ranged from 13° to 17°C, an increase from the morning 1200 UTC data. The axis of maximum winds at 850 mb extended from north-central Oklahoma through eastern Kansas. At 700 mb (figure 14), the maximum winds had intensified to 60 knots and extended from the Texas Panhandle across north-central Oklahoma into eastern Kansas. These strengthening winds at low levels in the atmosphere provided one of the necessary ingredients for the formation of the tornadoes.

Data from 27/0000 UTC indicated that the middle level (500 mb [figure 15]), short-wave trough had rotated northeastward from the base of the long wave trough and extended from southeastern Colorado into northwestern Texas. This trough of low pressure increased the diffluence over northern Oklahoma and southern Kansas as evidenced by the differences in wind speed and direction at Oklahoma City, Oklahoma, and Dodge City, Kansas. This was one meteorological feature that supported the upward motion needed to lift the air to produce thunderstorms.

The final ingredient which appeared to initiate this severe weather outbreak was a band of maximum winds near the top of the troposphere. This area of strong winds is referred to as the jet stream. Within the jet stream, there are regions of maximum winds referred to as a jet streak or a jet max. One such jet max was evident on satellite imagery throughout the day of April 26 (figures 16a-f). A jet max was rotating northeastward through western Kansas and the Oklahoma/Texas Panhandles around the upper level low located in Wyoming.

Although the air mass was primed for thunderstorm development, most cumulus clouds along the dry line were unable to develop into thunderstorms during the early afternoon. Convection developed rapidly once the upper level jet streak moved into a favorable position to support the upward motion. Jet streak signatures are often observed in satellite imagery. Detailed digital satellite data are available at the national centers (NC), such as NSSFC and the National Meteorological Center (NMC), through the VAS (VISSR [Visible and Infrared Spin Scan Radiometer] Atmospheric Sounder)

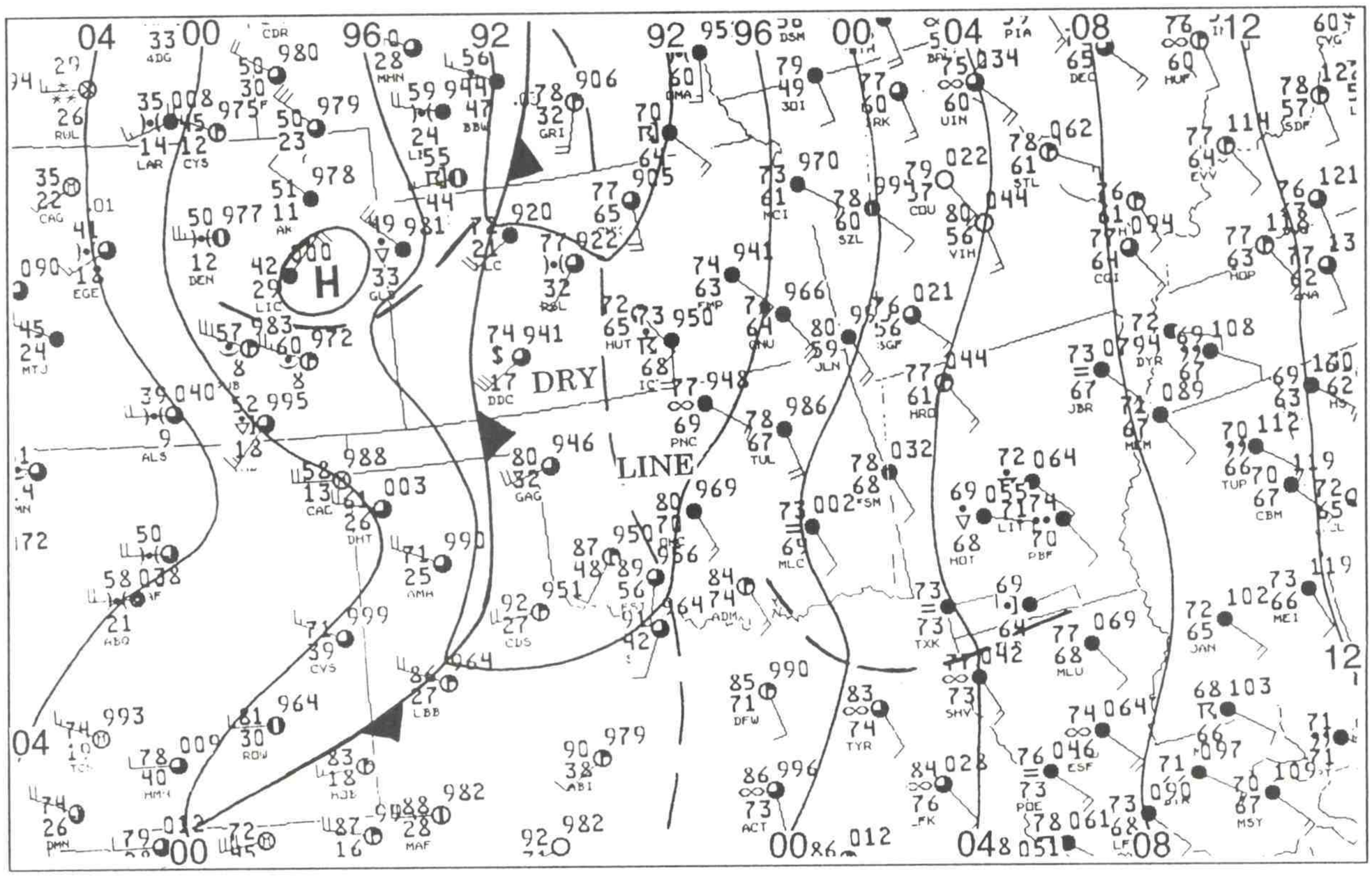


Figure 12. Surface analysis for April 26, 1991, 2300 UTC.

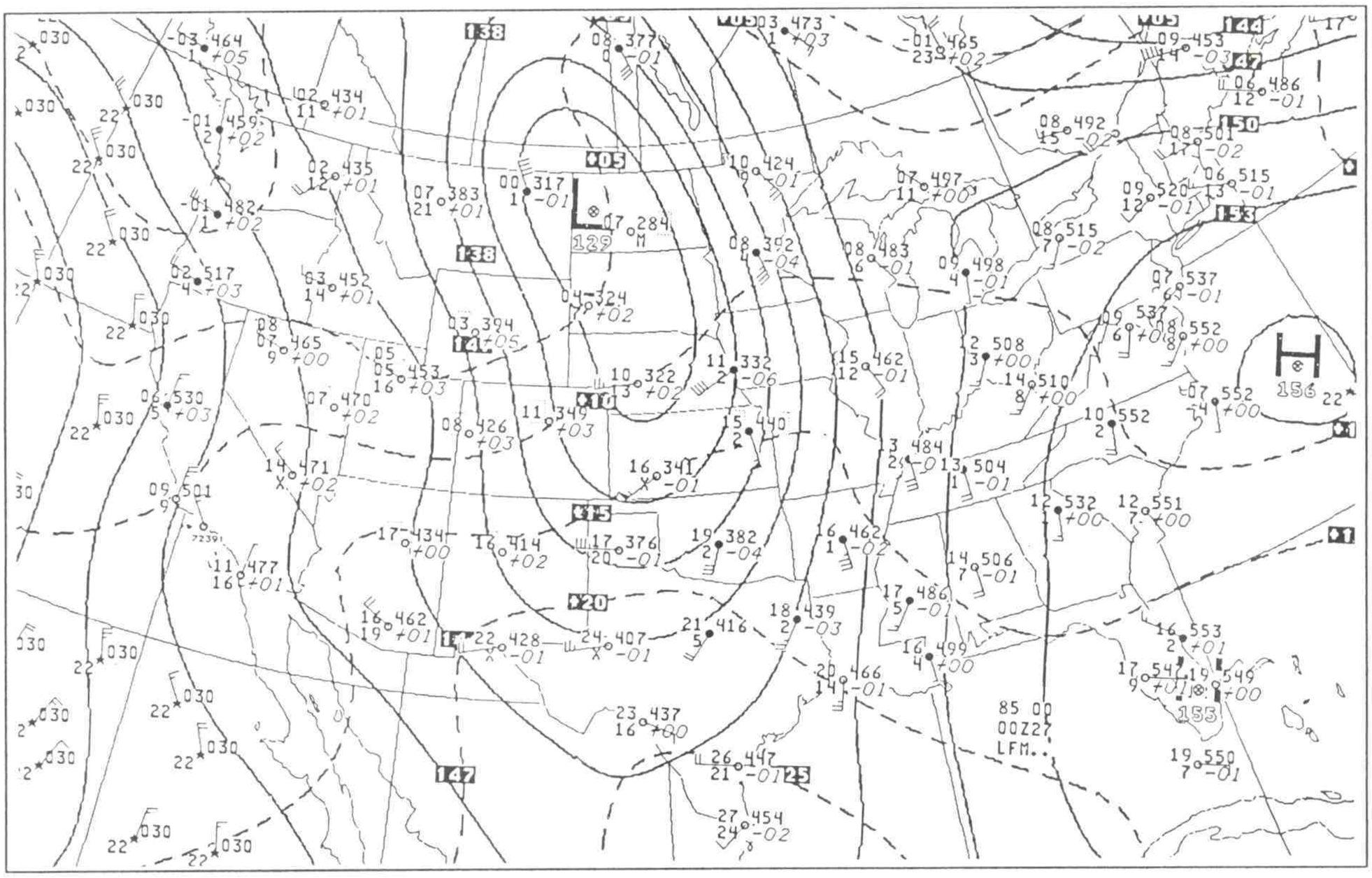


Figure 13. 850 mb analysis for April 27, 1991, 0000 UTC.

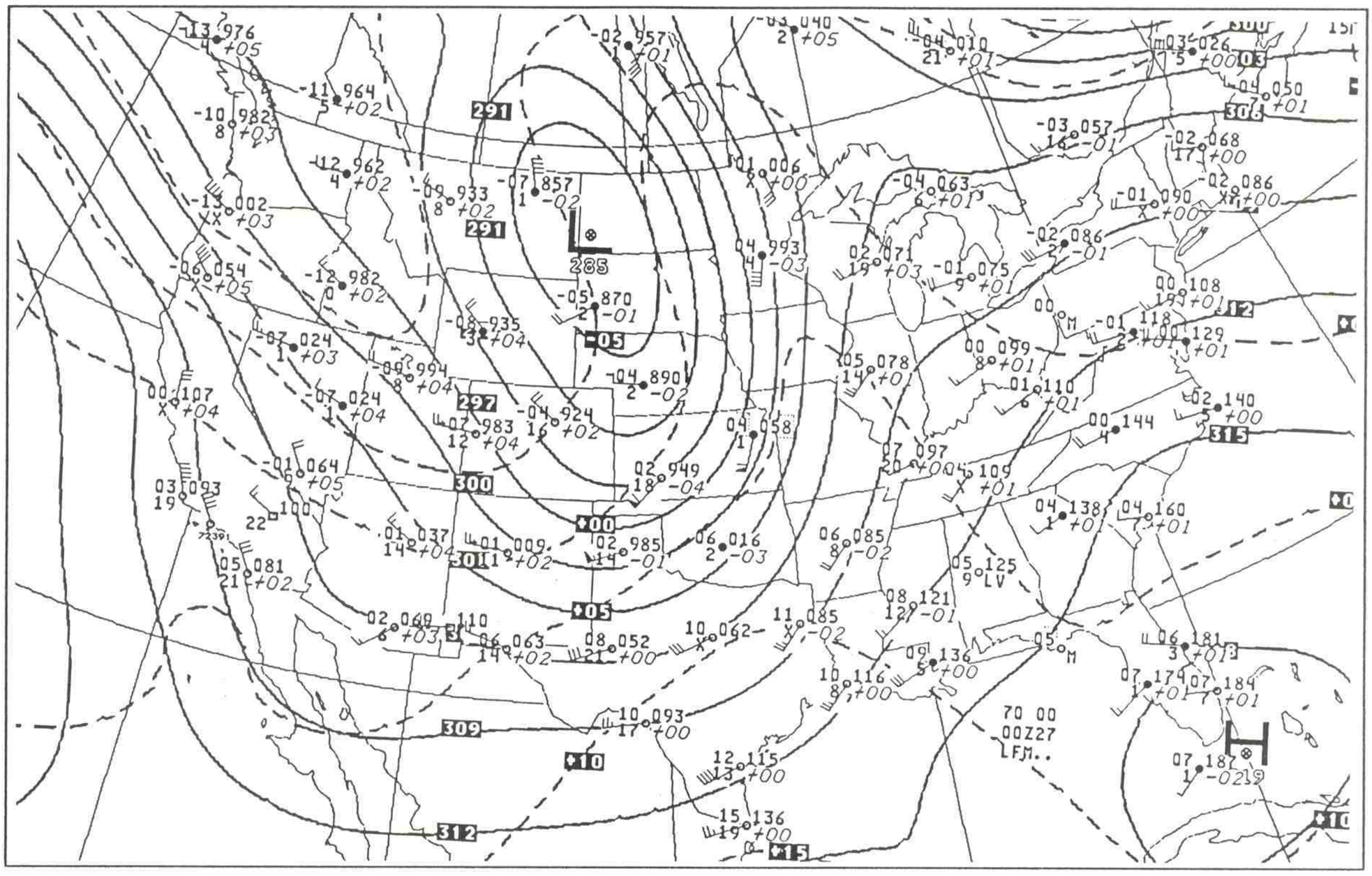


Figure 14. 700 mb analysis for April 27, 1991, 0000 UTC.

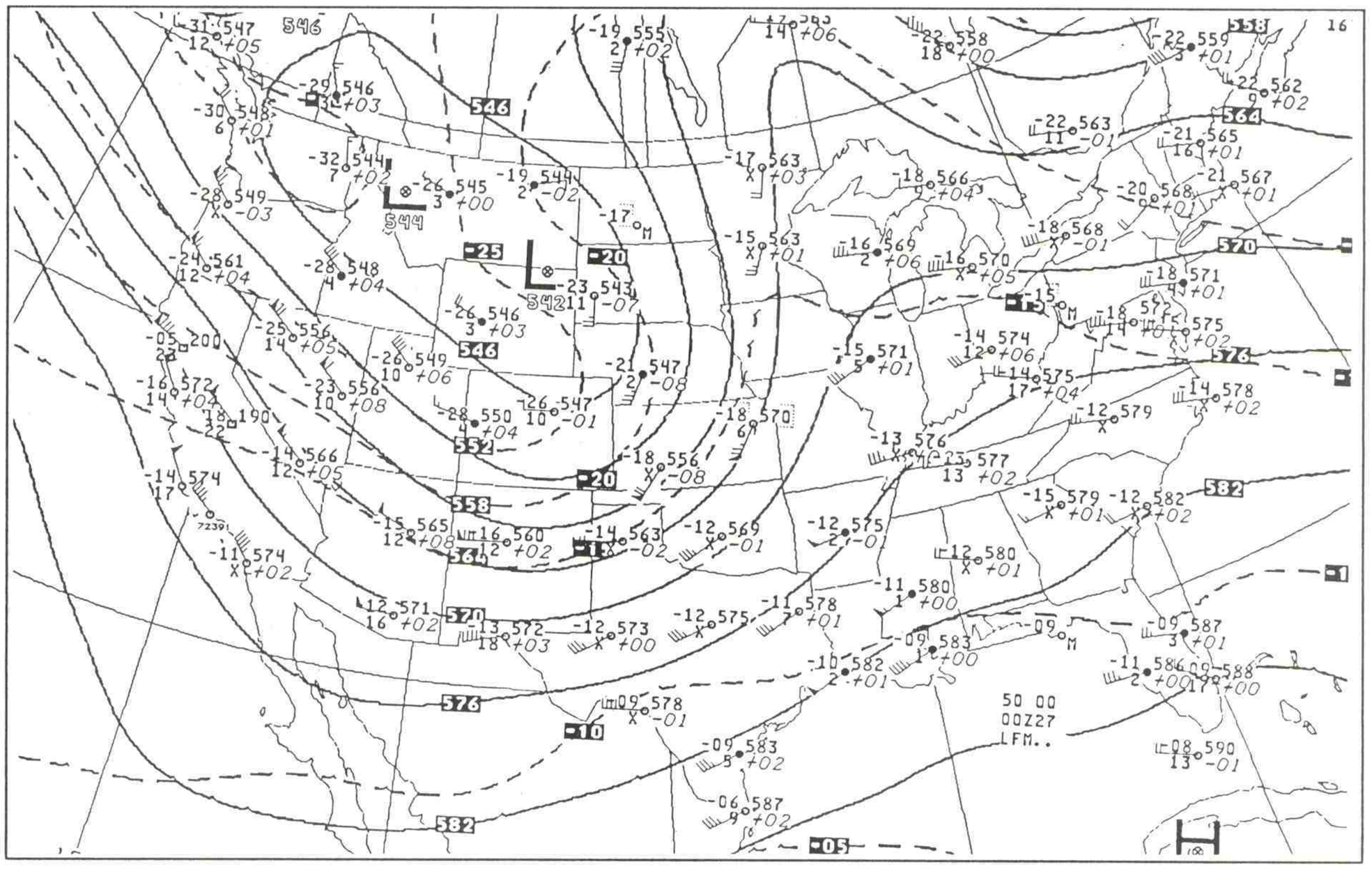
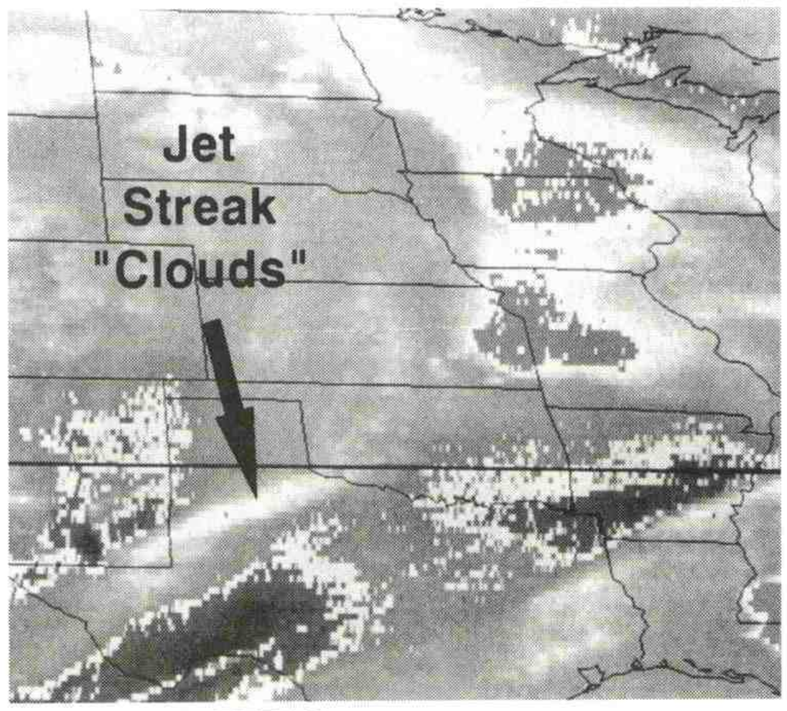
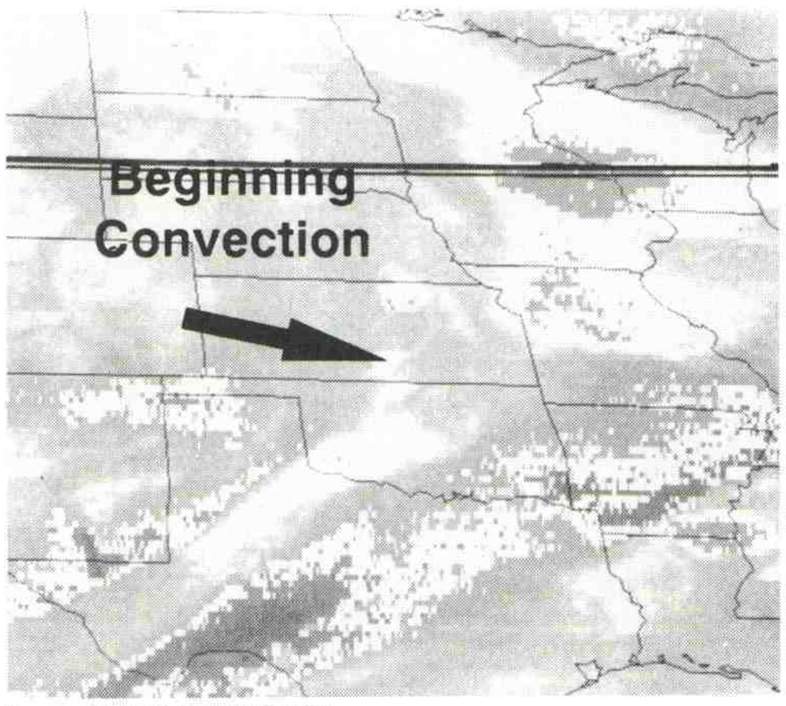


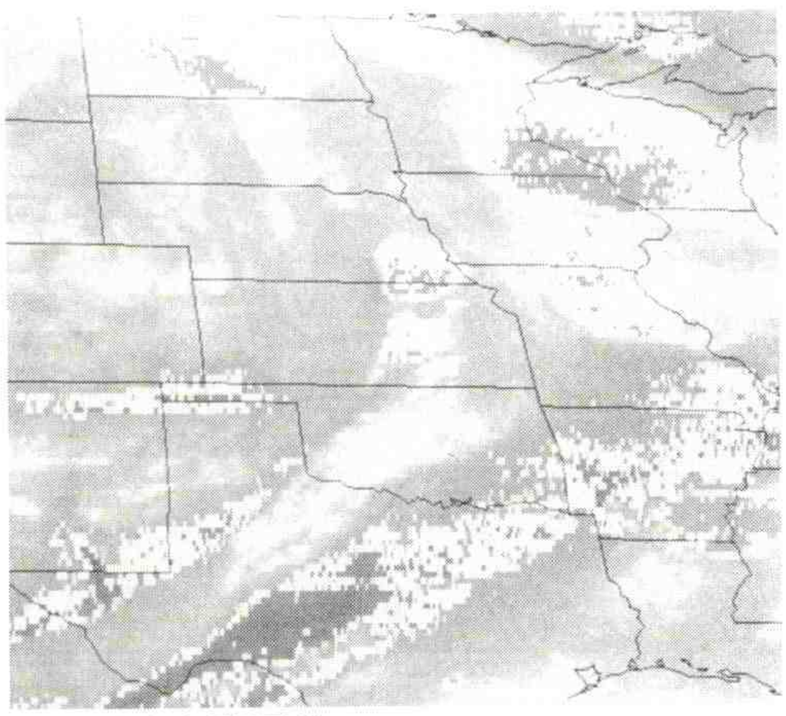
Figure 15. 500 mb analysis for April 27, 1991, 0000 UTC.



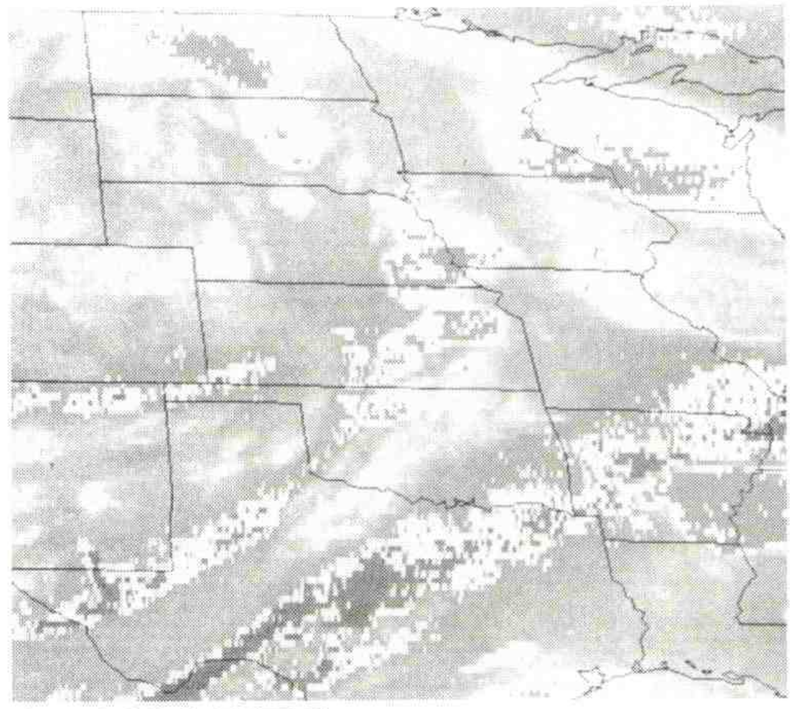
a. 1701 UTC



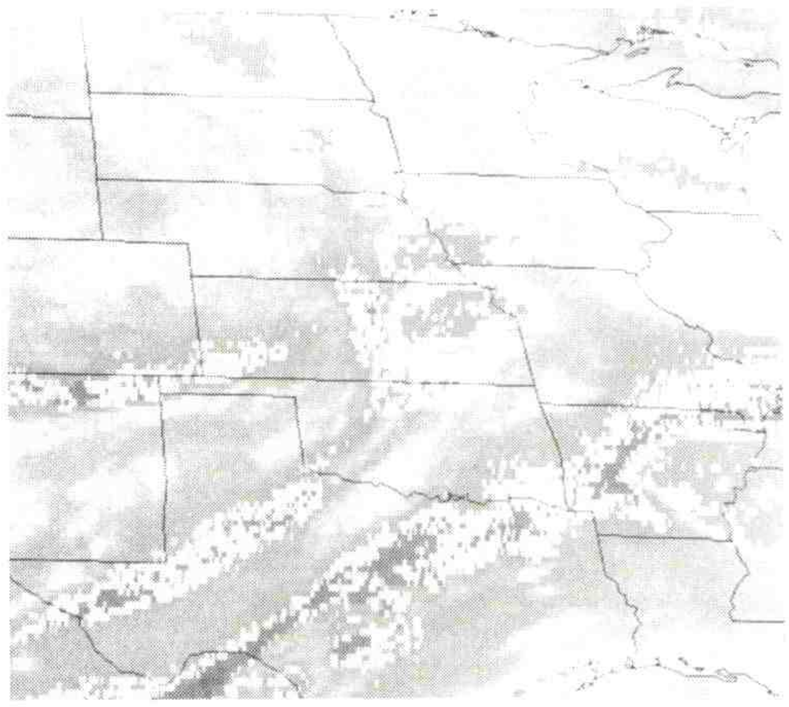
b. 1901 UTC



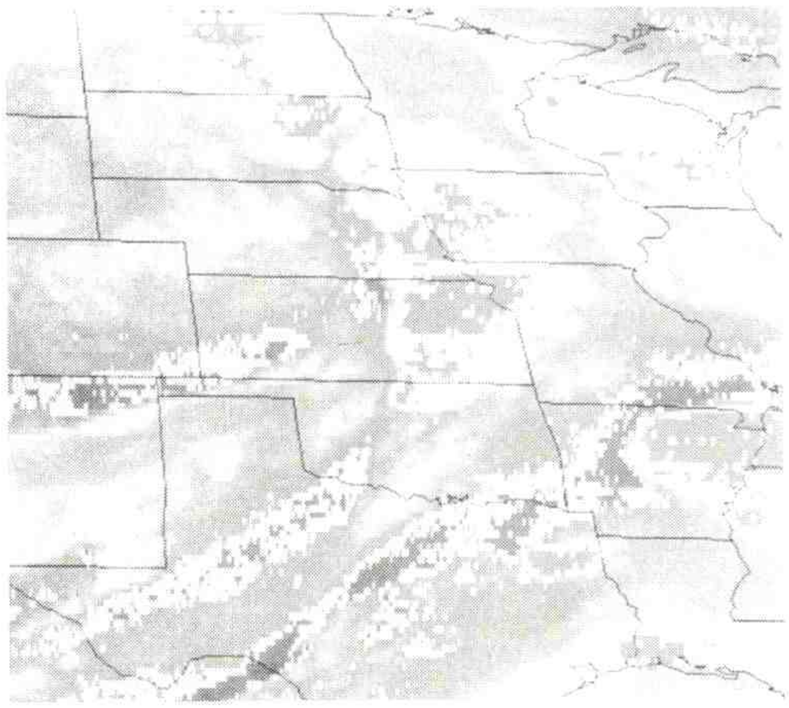
c. 2001 UTC



d. 2101 UTC



e. 2201 UTC



f. 2301 UTC

Figures 16a-f. Sequence of satellite water vapor images showing the jet streak approaching the Kansas/Oklahoma area and the subsequent thunderstorm development. The jet streak approaches from the southwest (figure 16a), reaches Kansas and initiates the convection in 16b. Figures 16c-f show the continued development of the convection.

Data Utilization Center (VDUC) system. Satellite data is available up to five times per half hour during selected 2-hour periods at the NCs. The data include infrared, visible, and water vapor (VAS) imagery. This detailed data was only available to the NCs. WSFO Topeka had only 30-minute imagery available in a mix of visible and infrared enhancements through the Satellite Weather Information System (SWIS). WSO Wichita did not have any real-time satellite imagery available. Infrared imagery (figures 17a-f) show the approach of the jet streak and the rapid generation of the convection. One kilometer resolution visible satellite imagery (figures 18a-f) show the explosive development of the convection across Oklahoma and Kansas. A strong dry intrusion (dissipating clouds) can be noted on the 2330 UTC visible image (figure 18e) just west of Andover (located by the +). This "dry punch" is a distinct satellite signature of severe weather.

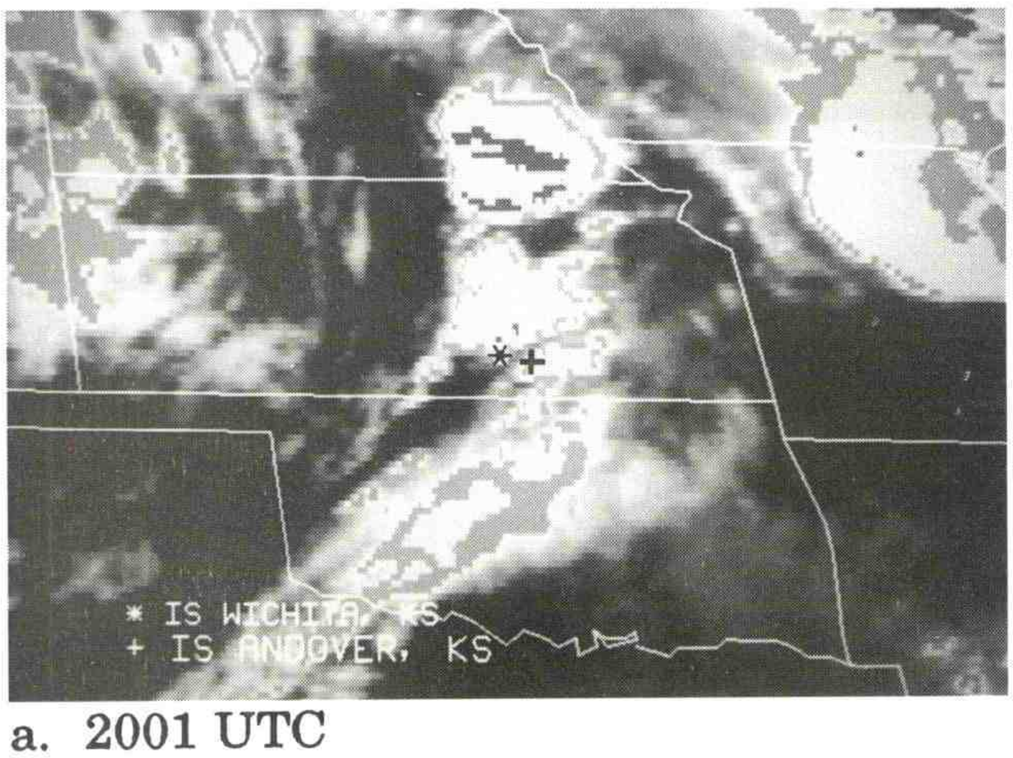
Finding 2.1: The synoptic weather situation that occurred on Friday, April 26, was a classic tornado outbreak pattern.

Finding 2.2: The 3 km helicity values were supportive of violent tornadic formation.

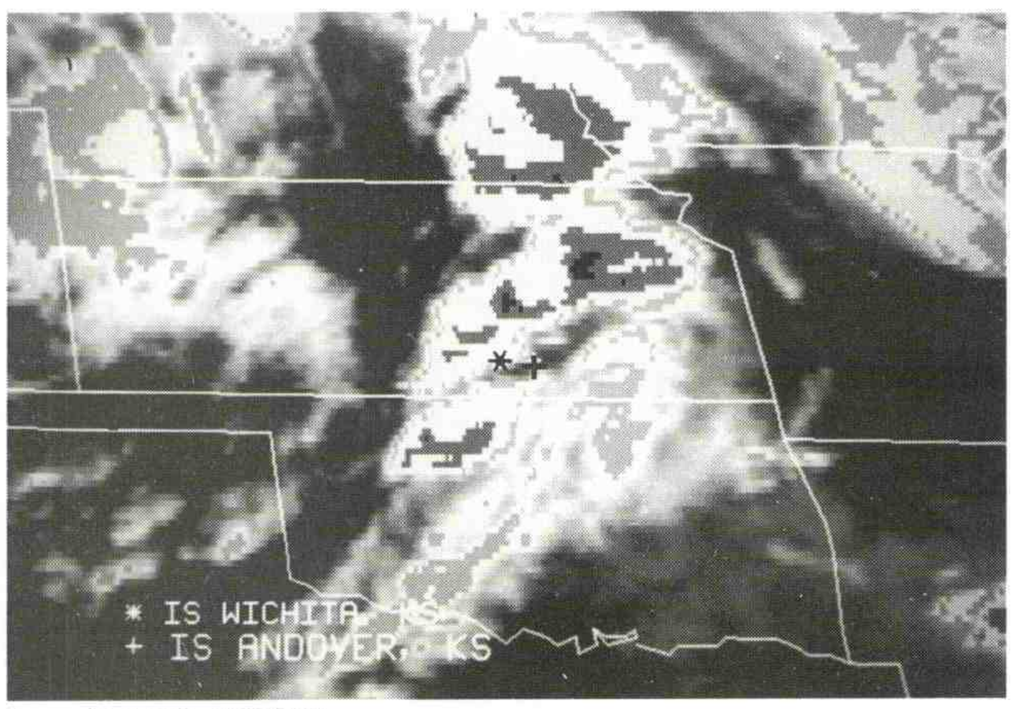
Finding 2.3: Satellite information available at the NCs is far superior to that which is currently available at WSFOs or WSOs. The digital data available on the VDUC system dwarfs the information available on SWIS.

Recommendation 2.3: The NWS should implement its modernization plan including provision of state of the art digital satellite data to all field offices. This information is vital for forecasting initiation and dissipation of mesoscale convective events.

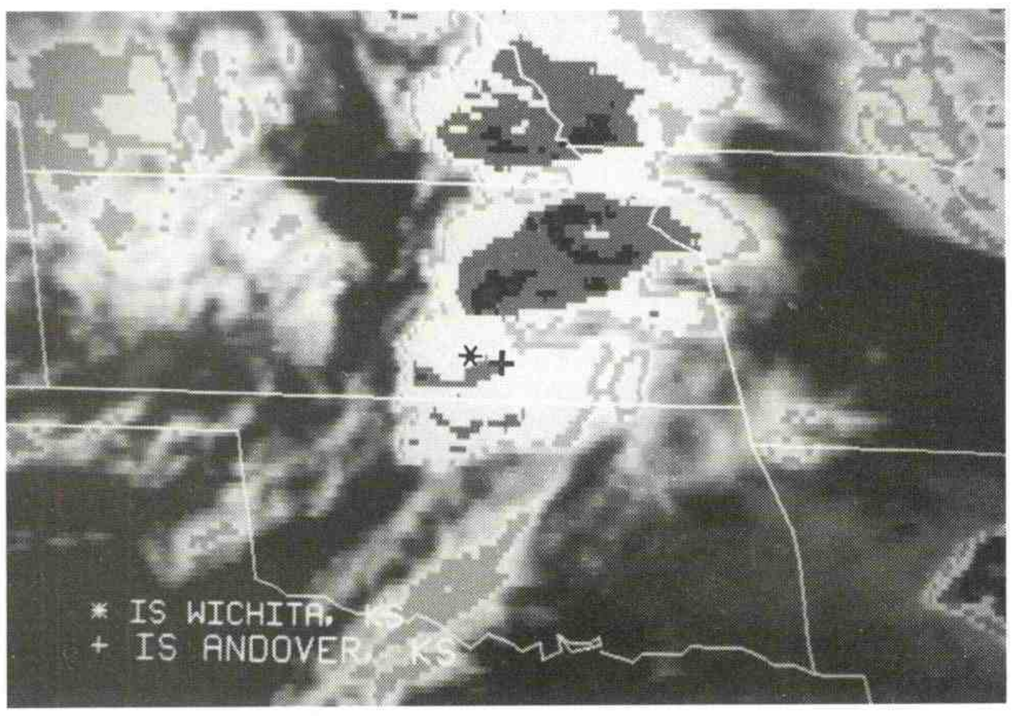
Large metal projectile imbedded in a telephone pole (McConnell Air Force Base). Photograph courtesy of John Sokich, NWS.



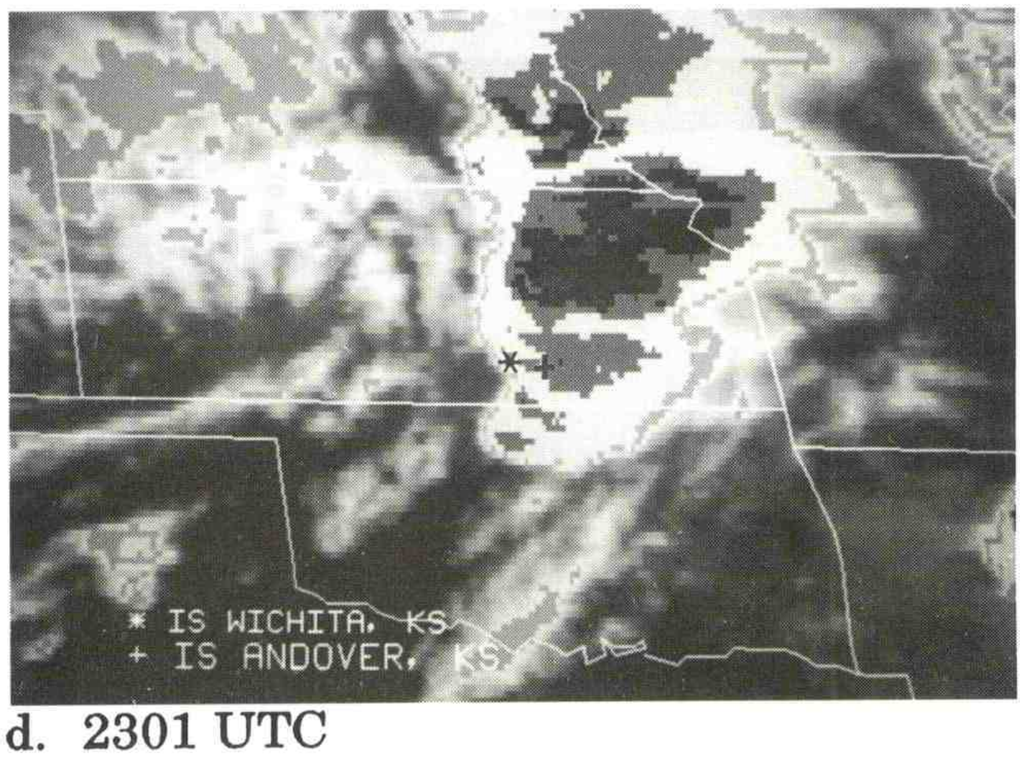
a. 2001 UTC



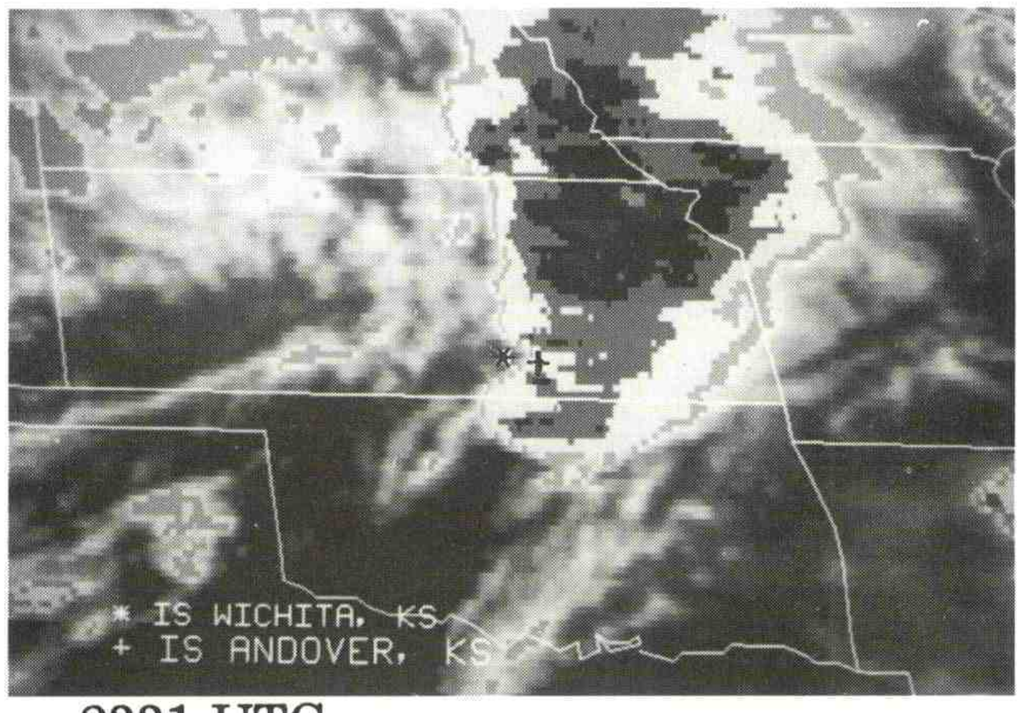
b. 2101 UTC



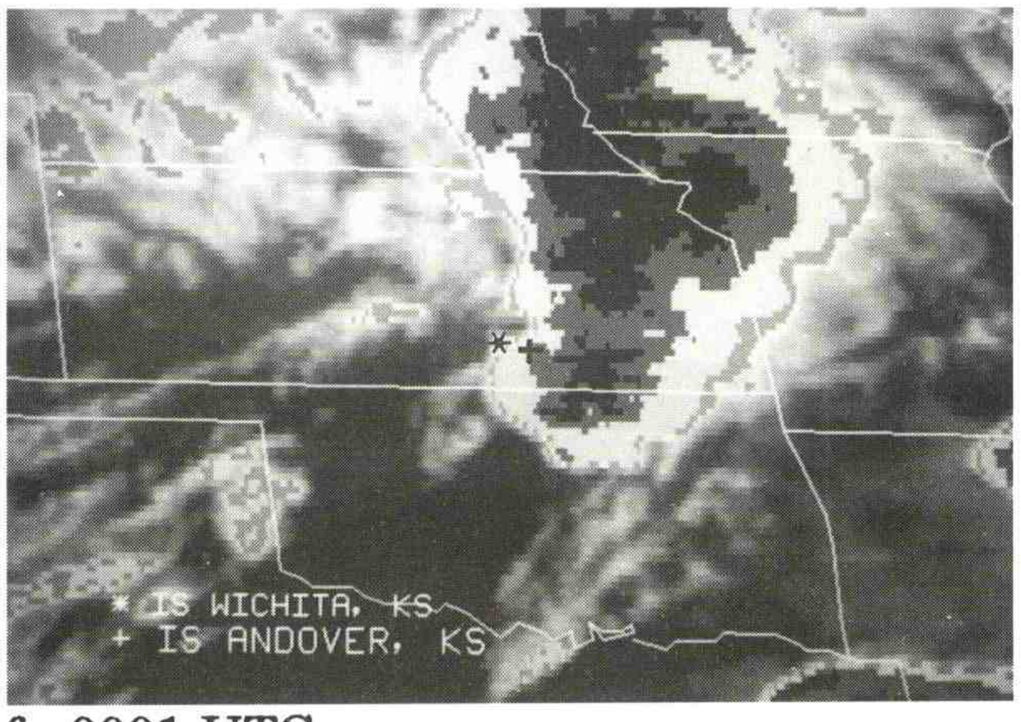
c. 2201 UTC



d. 2301 UTC

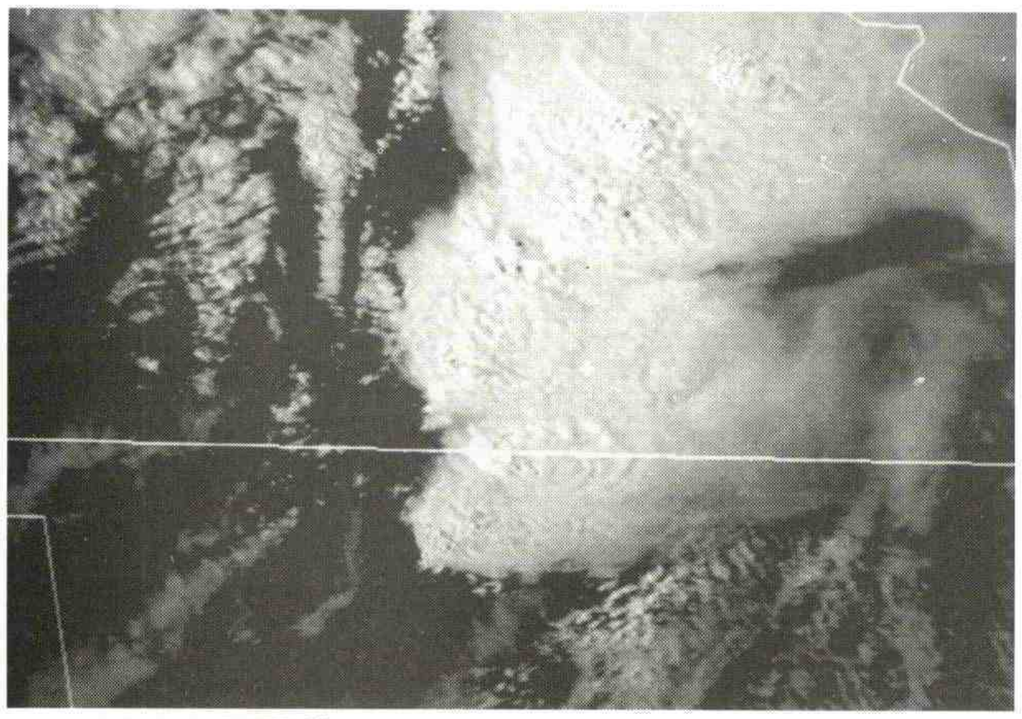


e. 2331 UTC

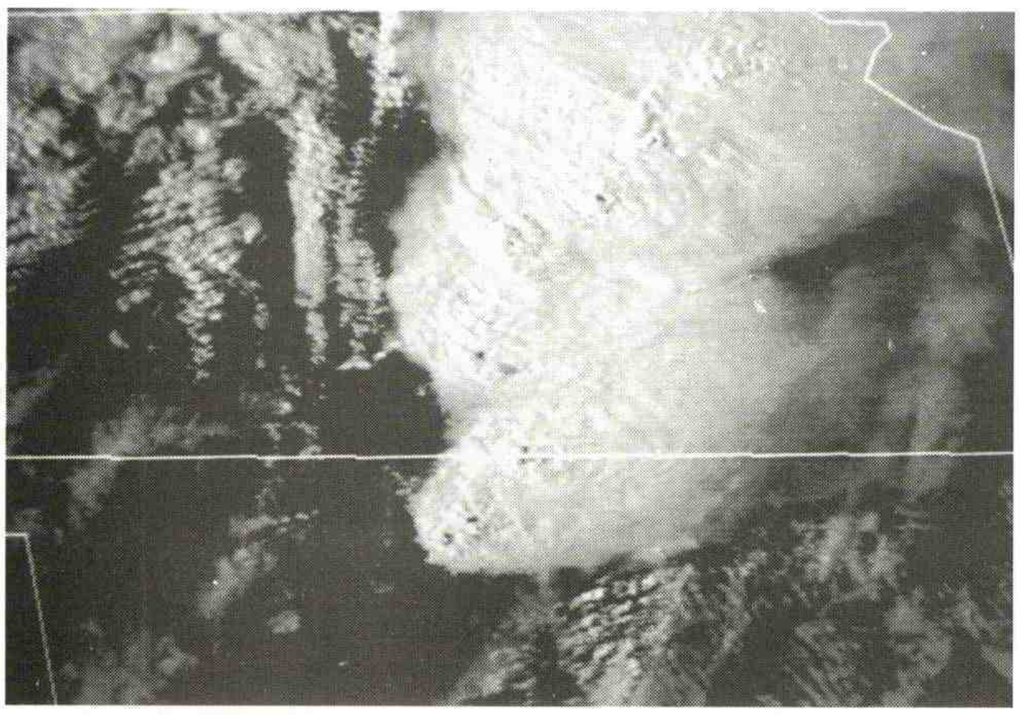


f. 0001 UTC

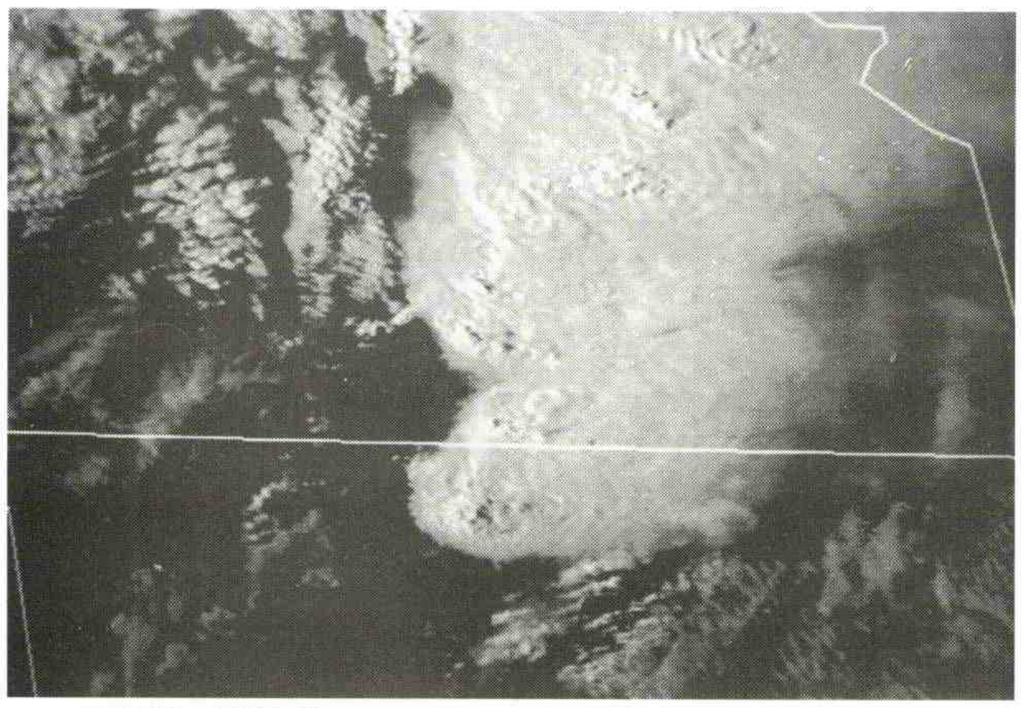
Figures 17a-f. Infrared satellite imagery from April 26, 1991, showing the rapid thunderstorm development as the jet streak approached.



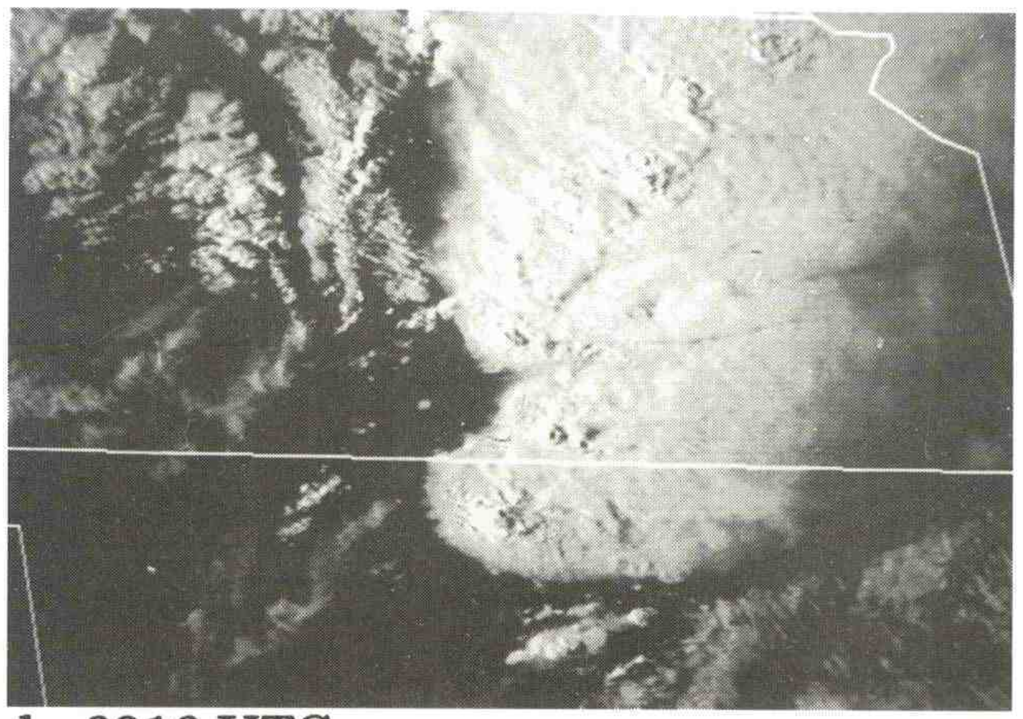
a. 2231 UTC



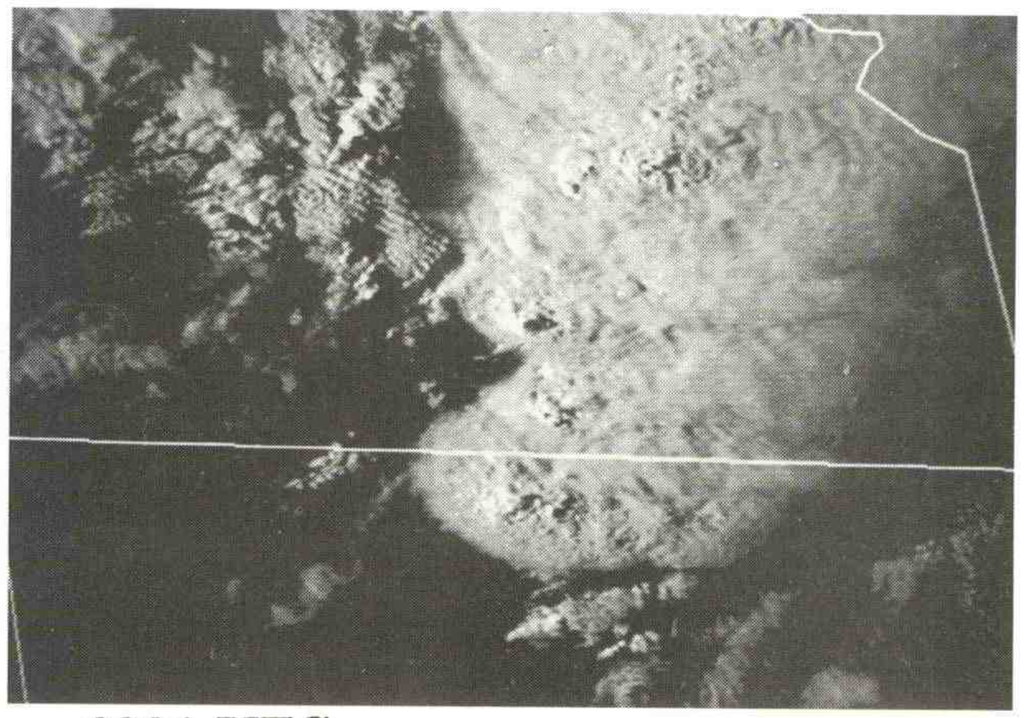
b. 2246 UTC



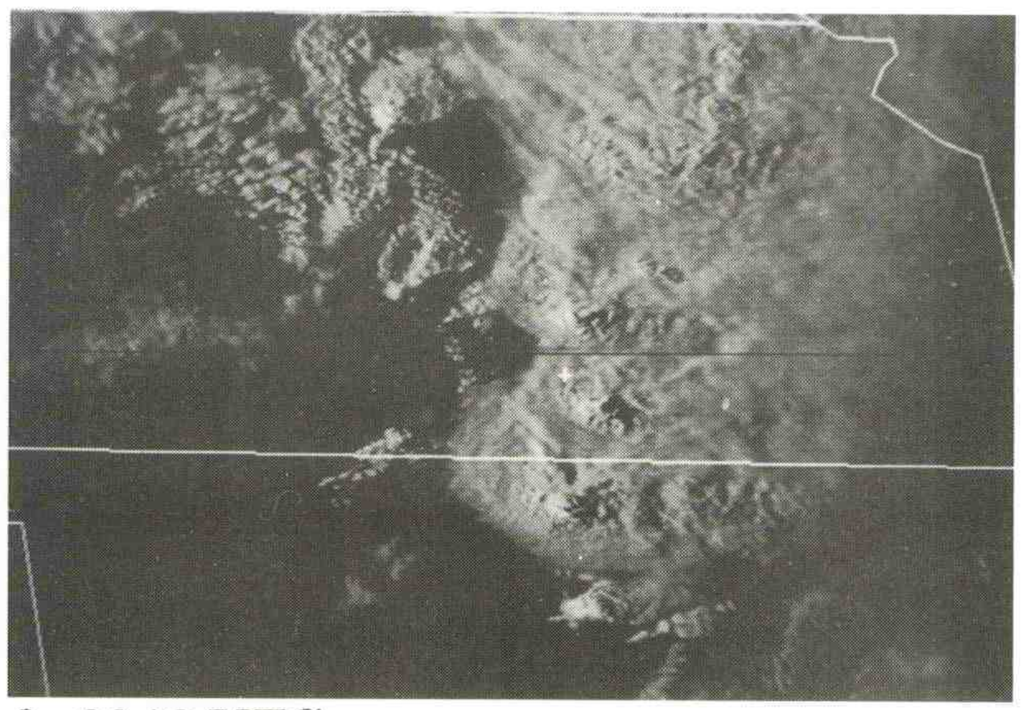
c. 2301 UTC



d. 2316 UTC



e. 2331 UTC



f. 2346 UTC

Figures 18a-f. One kilometer visible satellite imagery every 15 minutes from 2231 UTC to 2346 UTC on April 26, 1991. The town of Andover is designated by the +. The active portion of the supercell is located to the north-northeast of Andover on the 2346 UTC image, about 6 minutes after the mobile home park was leveled.

Wide angle view towards the east showing residential area west of the Golden Spur Mobile Home Park where the tornado reached F5. The mobile home park is located in the upper left-hand corner. Photograph courtesy of Paul Bowen.

CHAPTER 3

WARNINGS, FORECASTS, AND GUIDANCE

Current NWS forecast procedures begin with the centrally produced computer guidance at NMC in Camp Springs, Maryland. National severe weather guidance is prepared at NSSFC using the computer guidance. WSFOs, in turn, refine the guidance and issue detailed state forecasts while WSOs are responsible for issuing local forecasts, statements, and short-fused warnings.

The warning and forecast process of the NWS worked exceptionally well during the April 26 outbreak of tornadoes. Computer guidance from NMC, national outlook and watch products issued by NSSFC, state products and forecasts issued by WSFO Topeka, and local products issued by WSO Wichita all highlighted the potentially dangerous weather situation for that day. All messages were well written and contained appropriate information emphasizing the potential hazards of the weather for April 26.

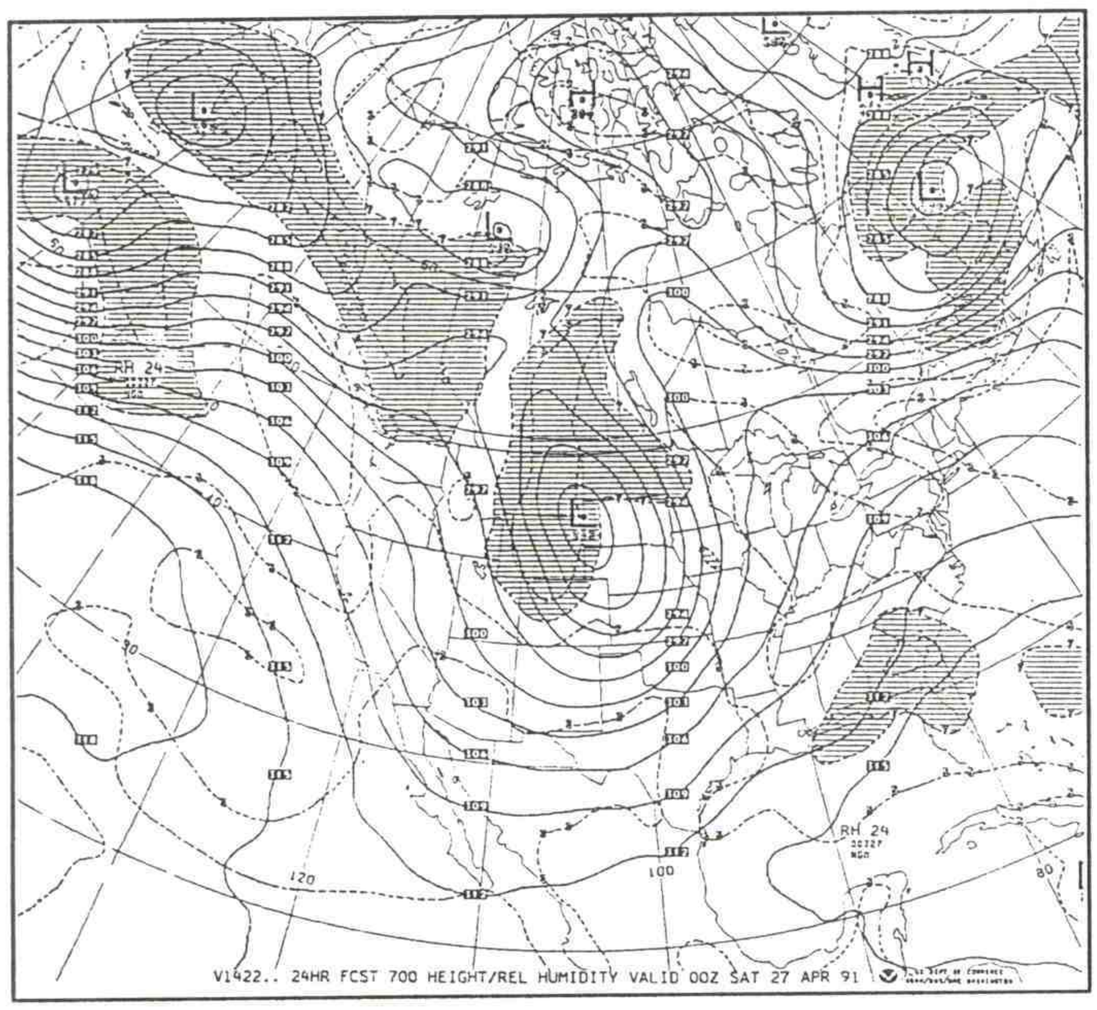
NMC

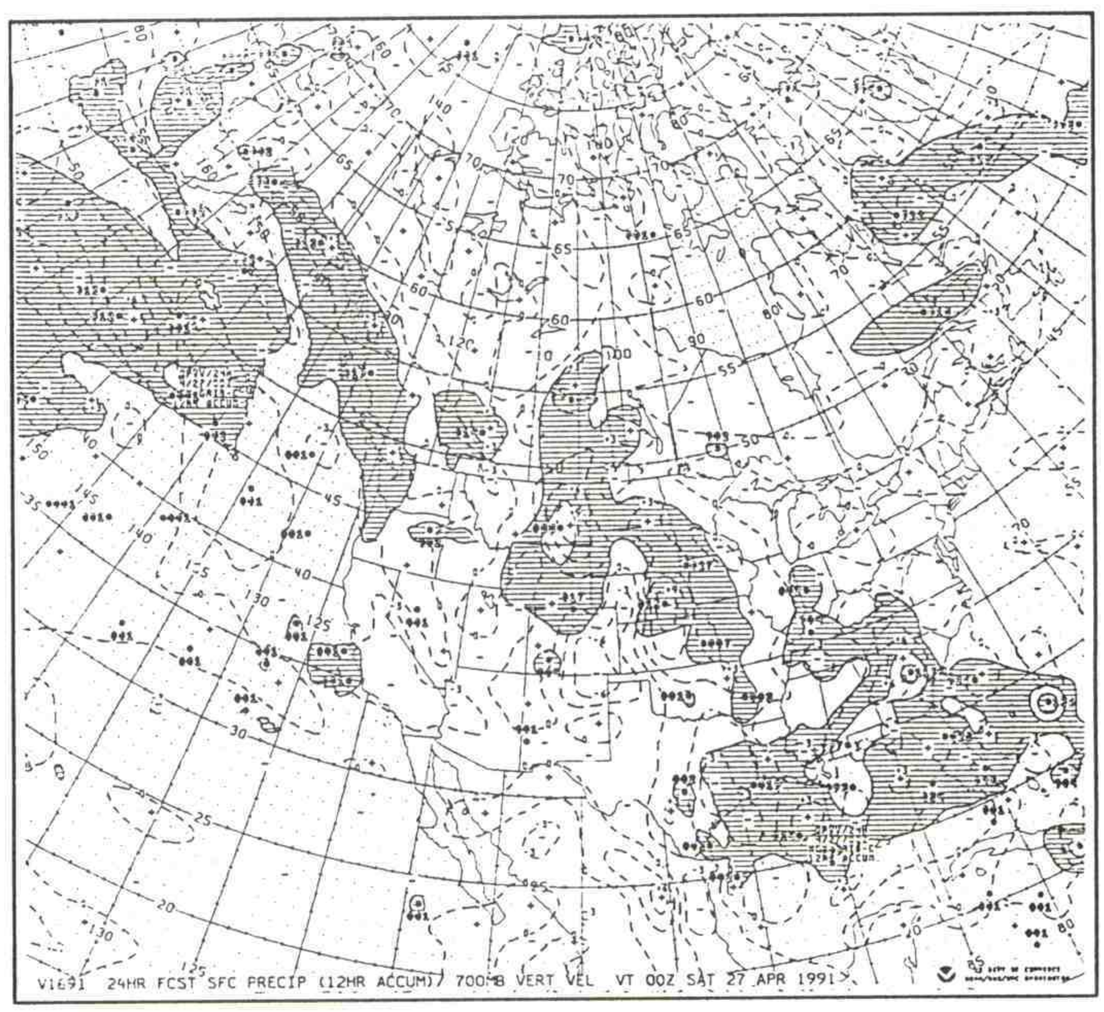
The large outbreak of severe weather that occurred on April 26 came as no surprise to NWS forecasters at both the national and local levels. The three computer guidance forecast models generated at NMC indicated for several days that the weather pattern over the Central Plains would be favorable for the development of strong thunderstorms, including severe weather and possibly tornadoes, for Friday, April 26. The primary short-range (through 48 hours) operational model used by NWS forecasters is the Nested Grid Model (NGM).

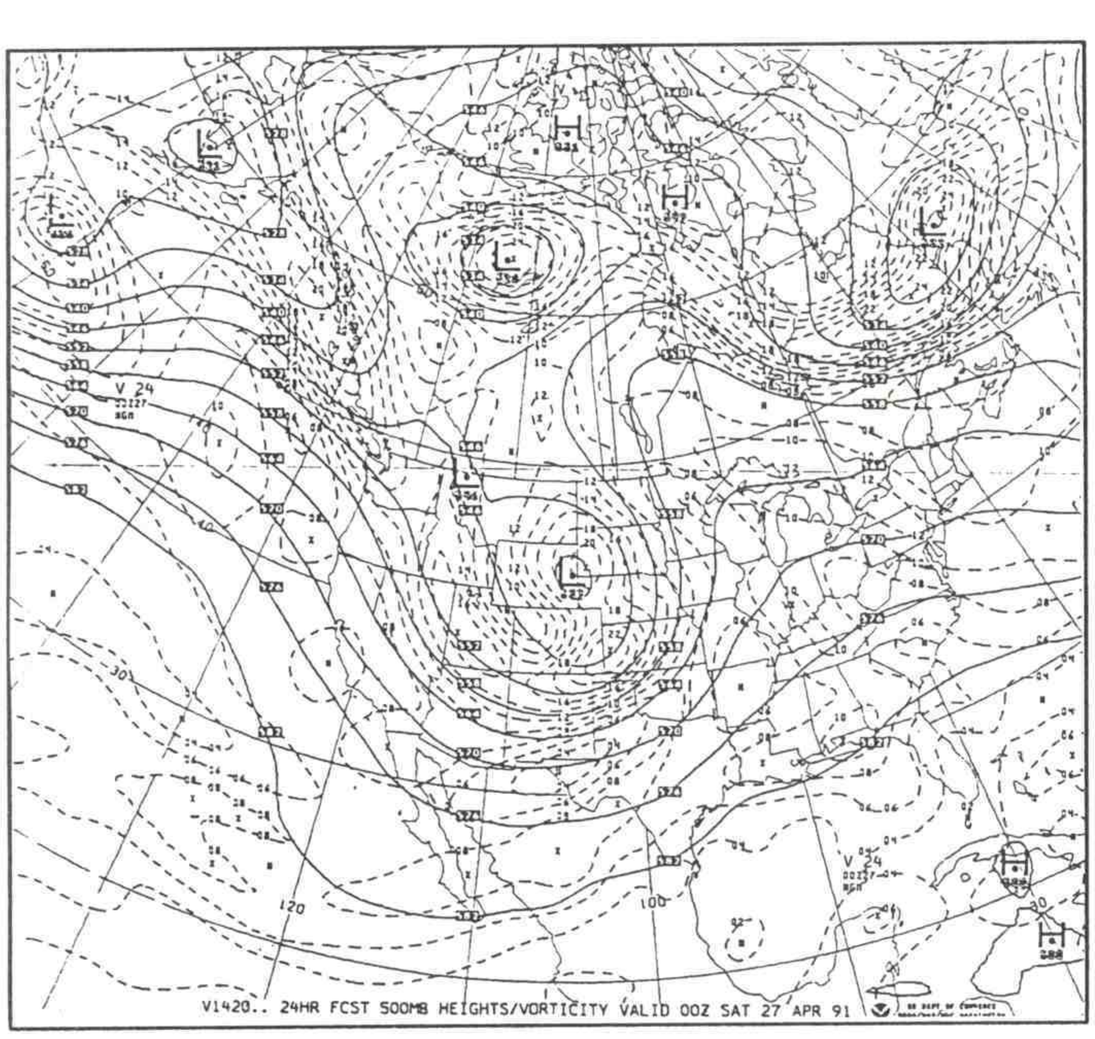
The NGM model accurately forecast the synoptic environment which was present on Friday, April 26. Numerical models are not expected to predict the exact location of thunderstorm development. The NGM did, however, an excellent job forecasting the potential for extensive convection across the Plains on April 26. Figure 19 shows the NGM 24-hour forecast valid April 27, 0000 UTC.

NSSFC

The potential for severe weather in Kansas on Friday, April 26, was initially identified in the Day 2 Severe Weather Outlook issued by NSSFC at 3 a.m. (25/0800 UTC) on Thursday, April 25 (see appendix D for products and messages issued by NSSFC). This outlook stated that tornadic activity was likely ahead of a cold front that was forecast to move eastward across the Central and Southern Plains Friday afternoon and evening. On Thursday afternoon at 1:08 p.m. (25/1808 UTC), NSSFC updated the Day 2 Severe Weather Outlook and







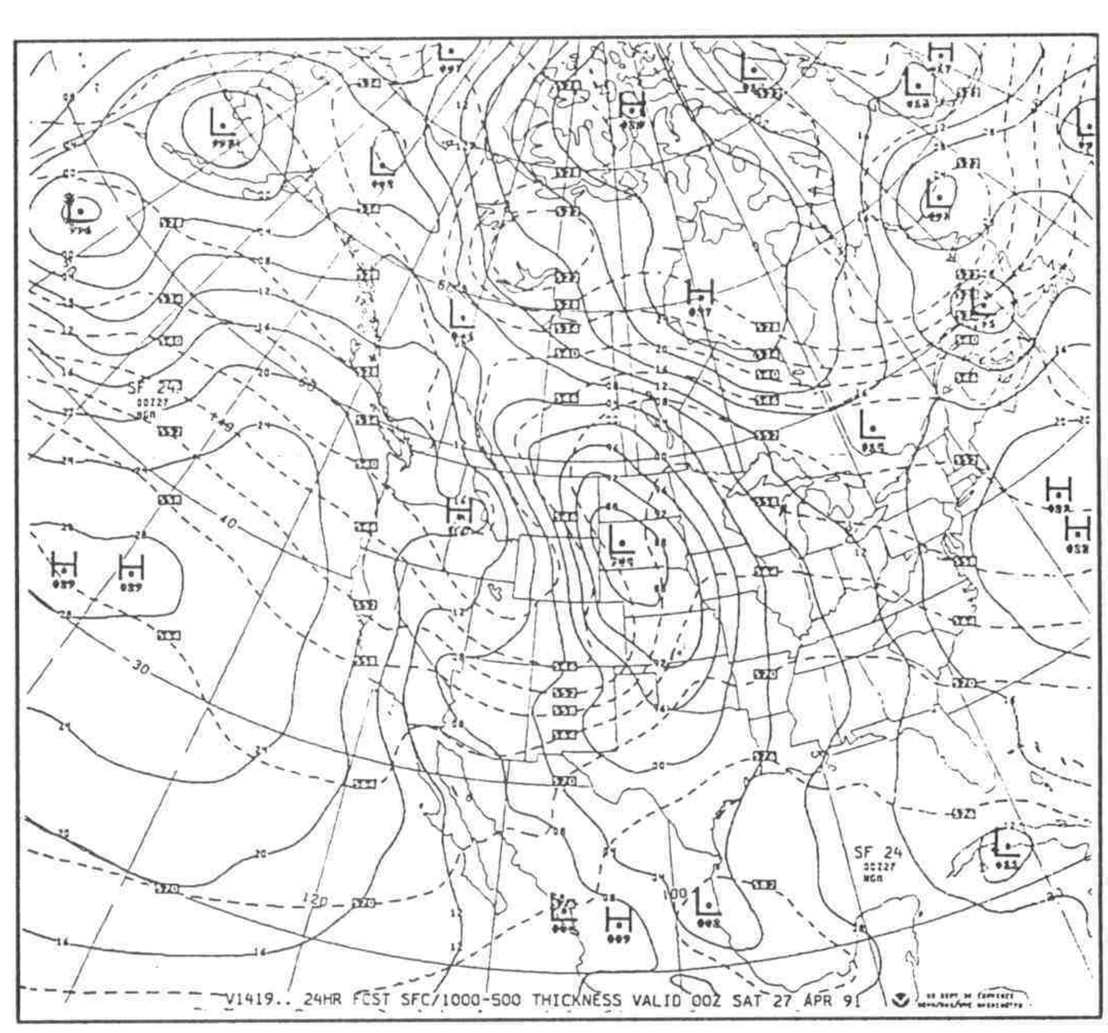


Figure 19. 24-hour NGM forecast valid April 27, 1991, 0000 UTC.

again emphasized the potential for a significant tornado outbreak in the central United States on Friday, April 26.

On the morning of April 26, NSSFC issued the Day 1 Convective Outlook at 2 a.m. (26/0700 UTC). This outlook indicated a "high risk" of severe weather Friday afternoon and evening over parts of the Plains, including central and eastern Kansas. The outlook emphasized that an outbreak of severe thunderstorms and tornadoes was expected in the high risk area. The "high risk" designation is seldom issued by NSSFC and reserved for when a major severe weather outbreak is anticipated.

NSSFC issued a Public Severe Weather Outlook (PWO) at 4 a.m. (26/0900 UTC) stressing that an outbreak of severe thunderstorms and tornadoes was expected Friday afternoon and evening in parts of the Plains, including central and eastern Kansas. The PWO is a special product that NSSFC issues when an especially significant and widespread outbreak of severe weather and tornadoes is expected. This product is used very infrequently and is a strong stimulus emphasizing the severity of the event.

NSSFC updated the Day 1 Convective Outlook at 9:38 a.m. (26/1438 UTC) and updated the PWO at approximately 11 a.m. (26/1508 UTC). (Any differences between the CDT and the UTC result from the delay in writing the message and final transmission. The dissemination time is the UTC time.) The messages continued to emphasize the threat for "destructive" tornadoes to occur within the "high risk" area outlined for the Central Plains.

At 12:10 p.m. (26/1710 UTC), NSSFC issued Tornado Watch No. 183, effective until 8 p.m. (26/0000 UTC) for parts of central and eastern Kansas. The watch was strongly worded, emphasizing this was a dangerous weather situation and "very damaging tornadoes" could develop.

Numerous mesoscale convective discussions were issued by NSSFC throughout the day to keep field offices apprised of the current meteorological conditions as analyzed by NSSFC. Watch status messages were also issued by NSSFC to keep the watch information current.

NSSFC issued a total of 24 watches on April 26. The 14 watches issued during the evening shift was a record high number for any single shift.

WSFO Topeka

Forecasters at WSFO Topeka highlighted the severe weather potential in their State Forecast Discussion (SFD) issued at 3:06 p.m. (25/2006 UTC), Thursday, and included a 50 to 60 percent chance of thunderstorms in the zone forecast for the Wichita area (Kansas Zone 12) for Friday and Friday night. SFDs are intended as internal NWS products used to coordinate the forecast among adjacent WSFOs and local WSOs within a WSFO's area of responsibility. Due to the inherent uncertainty in

forecasting severe weather, it is usually impractical to mention severe weather in state forecasts and zone forecast products (ZFP) outside the 24-hour time frame. WSFO Topeka concurred with the NSSFC "high risk" assessment in their SFD issued at 3:08 a.m. (26/0808 UTC) and forecast "SCATTERED THUNDERSTORMS... SOME POSSIBLY SEVERE" in the Kansas Zone 12 forecast issued at 3:48 a.m. (26/0848 UTC). The Wichita area is covered by Kansas Zone 12. The forecasts issued by WSFO Topeka followed NWS policy to highlight important weather in ZFPs. However, the wording in the ZFPs did not convey the potential severity of the event.

On days when unusual weather is expected, NWS offices are encouraged to issue a special weather statement (SPS) to alert the user community to the possibility of the unusual weather. At 4:50 a.m. (26/0949 UTC), WSFO Topeka issued such an SPS emphasizing the severe weather threat and further defining the NSSFC "high risk" area within the state of Kansas. Another SPS issued by WSFO Topeka at 10:39 a.m. (26/1539 UTC) re-emphasized specific information on severe thunderstorm development in Kansas. This alerted emergency managers and spotter groups that an active severe weather day was expected. Taken together, the ZFP and the SPS products provided sufficient severe weather information for the public and for the emergency management community to make appropriate preparations.

WSFO Topeka issued the Kansas Areal Outline (AO) for NSSFC Tornado Watch No. 183 at 12:15 p.m. (26/1715 UTC). An AO, or redefining statement (Automation of Field Operations and Services [AFOS] category severe local storms [SLS]) is issued by the WSFO for its area of responsibility whenever NSSFC issues a watch affecting the WSFO. The AO lists the counties that are in the watch. The AO issued by WSFO Topeka identified Sedgwick and Butler Counties, including the city of Wichita, as being within the tornado watch area.

WSO Wichita

As the severe weather episode began to evolve, the WSO Wichita staff was augmented to handle the additional workload. A staff of five was used through most of the late afternoon and evening. Normally, only two employees would be on duty during that time. Local warnings, forecasts, and statements issued by WSO Wichita were well written, action provoking, specific, and contained appropriate call to action statements and safety rules. WSO Wichita also issued an SPS (5:22 a.m., 26/1022 UTC), emphasizing the potential for severe weather for their county warning area (CWA).

In an effort to more accurately define the chronology of the Wichita/Andover tornado, the survey team contacted the Kansas Gas and Electric Company for assistance. The failure of high voltage electrical transmission lines provides excellent time confirmation of the

tornado passage. Power companies can locate not only the site of such failures, but can pinpoint, with great accuracy, the time the power was disrupted. The following tornado chronology was developed by using power company data, radar data, and spotter reports.

The first tornado produced by the thunderstorm touched down briefly approximately 6 miles northeast of Anthony in Harper County between 5:10 p.m. and 5:15 p.m. on Friday, April 26, 1991. The second twister formed in eastern Harper County at 5:20 p.m. (approximately 5 miles west-southwest of Argonia), moved northeastward, and lifted northeast of Conway Springs in Sumner County. The third and most destructive tornado touched down just south of Clearwater in Sedgwick County approximately 5:57 p.m. and was in the western part of Haysville (71st St. and Meridian) at 6:16 p.m. The tornado reached McConnell AFB by 6:25 p.m. It crossed Andover Road and entered the Golden Spur Mobile Home Park at 6:40 p.m. It continued northeast and at 7:00 p.m. was just west of El Dorado near the Kansas Turnpike and dissipated shortly thereafter. The fourth tornado formed over El Dorado Lake and moved northeast. It dissipated around 7:20 p.m. northeast of Cassoday.

Based on the tornado chronology, the following warning lead times have been determined. In calculating the lead times, the time the warning was transmitted for distribution has been used instead of the time appearing in the mass media header. This is the most accurate way to assess the lead time that was given to the users. For Harper County, warning lead times ranged from zero minutes at the initial touchdown point to as much as 15 minutes at the point where the tornado exited the county. For Sumner County, warning lead times varied from 15 minutes at the point where the tornado entered the county to 28 minutes where the tornado exited the county. For Sedgwick County, warning lead times ranged from 7 minutes at the point where the tornado entered the county to 47 minutes where the tornado exited the county. For Butler County, warning lead times varied from 4 minutes at the point where the tornado entered the county to 47 minutes where the tornado dissipated in the northeast part of the county. Note: The 4-minute lead time for Butler County was computed using the 6:33 p.m. issuance time and the time the tornado first moved into Butler County.

WSO Wichita issued its first warning of the day at 6:42 a.m. (26/1147 UTC). On April 26, severe weather occurred in 17 of 22 counties of Wichita's CWA. A total of 17 tornado warnings, 33 severe thunderstorm warnings, and 44 severe or special weather statements were issued. The staff at WSO Wichita did an excellent job providing information to the public. The office received severe weather and tornado reports and immediately issued appropriate warnings and statements. See appendix E for a detailed chronology of the actions taken by WSO Wichita on April 26.

Data from WSFO Topeka and WSO Wichita indicated that commercial power was interrupted at WSO Wichita for approximately 10 minutes at about 6:45 p.m. The staff had planned to switch to emergency power at 5:30 p.m., but tornadoes were already reported by that time. Switching to backup power would mean that the WSO Wichita WSR-57 radar unit would be off line for approximately 15 minutes. The staff determined that it was inappropriate to switch to emergency power with tornadoes occurring within the WSO CWA. No warnings or statements were delayed by the outage.

The Wichita/Andover storm spawned four separate tornadoes that were visible from a large distance. This may have contributed to the confusion surrounding the apparently conflicting spotter reports. Spotters could see the tornadoes from relatively long distances possibly resulting in errors estimating the location of the tornado. Multiple vortices produced by the parent storm probably contributed to the seemingly contradictory reports regarding the location of the tornado. Some spotters may have been looking at the dissipating tornado while others were viewing a developing vortex. Also, in the excitement of the event, spotters may have reported a tornado giving their viewing location instead of the estimated location of the storm itself. Such confusion is not uncommon during an ongoing event and is similar to the "fog of war" phenomenon which occurs during military operations. This phenomenon complicates warning operations as the individuals responsible for issuing warnings must sift through large amounts of often conflicting information, and yet make split-second warning decisions. Nevertheless, the staff at Wichita handled this episode expertly.

The spotter networks in Sedgwick County were activated at 4:45 p.m. The Citizens Radio Emergency Services Team (CREST) and Radio Amateur Civil Emergency Service (RACES) both established base station operations in the Wichita office which relayed severe weather reports from the spotters to the WSO Wichita staff. These spotter reports were used to issue warnings; warnings which, in most cases, provided sufficient lead time for people to take necessary safety actions.

For comparison, the WSFO in Norman, Oklahoma, used the WSR-88D, with Doppler velocities and better reflectivity resolution, to detect ambient conditions that are precursors to tornado formation and to issue warnings. On the same day of the Wichita/Andover tornado, Oklahoma also had an extensive outbreak of severe weather. Using the WSR-88D, the Norman office was able to provide tornado warnings for sections of Oklahoma in many cases <u>before</u> the tornado touched down. In one case, the warning was issued with a 24-minute lead time <u>before</u> the tornado touched down. These tornadoes, recognized on the WSR-88D by the forecasters, were subsequently confirmed by spotters.

<u>Finding 3.1</u>: Synoptic scale parameters were exceptionally well forecast by the numerical models.

Finding 3.2: National Weather Service forecasters were well aware of the potential for damaging thunderstorms on Friday, April 26. As early as Thursday morning, forecasters were highlighting the potential for tornado development on Friday across the central and southern Plains.

Finding 3.3a: NSSFC provided excellent outlook and watch services for this event. The Day 2 Outlook identified the potential for tornadoes more than 37 hours in advance. PWOs issued by NSSFC provided extensive lead time and highlighted the severity of this event. Tornado Watch No. 183 was issued more than 6 hours prior to the time that the tornado moved through Andover.

Finding 3.3b: NSSFC issued a total of 24 watches on April 26. The 14 watches issued during the evening shift was a record high number for any single shift.

Finding 3.4a: WSFO Topeka followed established procedures to highlight the potential for severe weather in statements and forecasts. Products issued by WSFO Topeka were timely and informative. The wording of the ZFP follows the policy established in Weather Service Operations Manual (WSOM) Chapter C-40 "Severe Local Storm Warnings." The ZFPs issued by the Topeka WSFO did not differentiate this day from any other severe thunderstorm day.

Recommendation 3.4a: Change WSOM Chapter C-40 to encourage stronger wording in zone forecasts when "high risk" areas are outlined by NSSFC. For example, instead of "...50% CHANCE OF THUNDERSTORMS...SOME POSSIBLY SEVERE" the recommended wording could be "...SEVERE THUNDERSTORMS LIKELY...SOME MAY PRODUCE TORNADOES."

Finding 3.4b: On Thursday afternoon, April 25, WSFO Topeka recognized the potential for significant severe weather and highlighted the potential in the internal NWS SFD product. This information was not included in the ZFP issued that same afternoon.

Recommendation 3.4b: On days when the potential for severe weather is highlighted for the next day in the SFD, the NWS should encourage use of severe weather terminology in the ZFPs issued at the same time. This may enable emergency managers to better plan staffing for the severe weather episode. Highlighting the potential of a big event will also provide the public with more advanced notification to prepare for the event.

Finding 3.5: WSFO Topeka issued SPSs to emphasize specific information on severe thunderstorm development in Kansas.

Finding 3.6: WSO Wichita provided good warning services during an extremely active severe weather outbreak. Multiple events were occurring simultaneously in Wichita's area of responsibility, yet the tornado warnings for Sedgwick and Butler Counties were timely and effective.

Finding 3.7: Severe weather occurred in 17 of 22 counties in WSO Wichita's CWA. WSO Wichita issued a total of 17 tornado warnings, 33 severe thunderstorm warnings, and 44 severe or special weather statements.

Finding 3.8: Warnings and statements issued by WSO Wichita were well written, timely, action provoking, specific, and contained appropriate call to action statements and safety rules.

Finding 3.9: All of the tornado warnings issued by WSO Wichita were based on spotter reports.

Finding 3.10: Conflicting spotter reports, which placed the tornado in different locations at the same time, introduced confusion into the warning process and into the reconstruction of the post-storm tornado track and timing.

Recommendation 3.10: Spotter training should emphasize not only proper storm identification procedures but proper reporting procedures as well, i.e., spotter reports should clearly indicate the time the observation was taken and whether the location reference is an estimate of the storm location or the spotter's location. Whenever possible, the radar film should be used to assist in the reconstruction of the post-storm tornado path and timing.

Finding 3.11: Commercial power was interrupted at WSO Wichita during the event. The staff had planned to switch to emergency power at 5:30 p.m., but by that time a tornado was already reported southwest of Wichita. Wichita's Station Duty Manual recommends switching to emergency power when thunderstorms are within 25 miles of the station.

Recommendation 3.11: When practical, consideration should be given to switching to emergency power early on days when severe weather is expected. Factors, such as the high risk outlook, the tornado watch, and available fuel supply for the emergency generator should be given consideration in this decision. The Station Duty Manual should be worded to allow for this flexibility.

CHAPTER 4

RADAR EVALUATION

During convective events, forecasters rely on radar and spotter reports to determine if the thunderstorms are severe or tornadic. The Wichita WSR-57 is part of the NWS network radar and is located at the Wichita Mid-Continent Airport.

The WSR-57 radar provides only reflectivity data. The radar beam width is 2.0 degrees and the range of the radar is 250 nautical miles (nm) in all directions. High reflectivities indicate stronger storms with heavy rainfall. Other radar signatures, such as pendants or hook echoes, indicate the potential that the thunderstorm is producing severe weather or possibly tornadoes. The April 26 radar film from the Remote Plan Position Indicator (RPPI) on the Wichita WSR-57 radar was examined. The RPPI followed general NWS guidelines and remained on the 250 nm range for the duration of the event.

On April 26, the radar film showed the thunderstorm that would later produce the Wichita/Andover tornado developing about 100 miles southwest of Wichita around 3 p.m. This storm developed into a supercell, and at 4:40 p.m., a pendant was evident in the reflectivity field with the storm located about 50 nm southwest of Wichita. The Wichita radar had been operating with an automatic tilt sequence prior to this time but not while the pendant was evident. From this distance and without the benefit of more detailed tilt sequences, it was not possible to determine the storm structure features associated with this storm.

At 5:05 p.m., this same storm was located about 30 nm southwest of Wichita. The tilt sequence revealed the presence of a large mid-level overhang extending more than 10 miles to the south and southeast of the low-level reflectivity gradient. An overhang on radar indicates that heavy rain or hail is not able to reach the ground due to a very strong updraft. A storm possessing an extensive mid-level overhang is usually indicative of a severe thunderstorm. The radar film showed a pendant with this storm about 20 nm south-southwest of Wichita 35 minutes later. This storm spawned two weak tornadoes in extreme eastern Harper County and northwestern Sumner County between 5:10 p.m. and 5:45 p.m.

The third tornado with this storm was reported on the ground near Clearwater in southwest Sedgwick County at 5:57 p.m. The storm was in the ground clutter of the Wichita radar as it moved northeast through eastern Sedgwick County and into western Butler County. This tornado was most intense prior to and while it moved through the small town of Andover, Kansas.

The second supercell, as observed by the Wichita radar, developed in northwest Oklahoma about 120 nm south-southwest of Wichita at 4:40 p.m. This storm produced a killer tornado in Cowley and Elk Counties in southeastern Kansas between 6:30 p.m. and 7:30 p.m. The quality of the radar film, radar range of 250 nm, and the distance of the storm from the radar prevented recognition of significant low-level or storm structure features indicative of a tornadic storm.

On April 26, strong thunderstorms and tornadoes also occurred in northern Oklahoma. Three of the twisters reached F4 intensity. The WSR-88D, located near Oklahoma City, Oklahoma, was operating during the tornado outbreak of April 26. The WSR-88D has both reflectivity and Doppler velocity capabilities. The reflectivity range of this radar is 248 nm while the Doppler velocity capability is 124 nm. The azimuthal beam width of the WSR-88D is approximately .95 degrees compared with 2.0 degrees for the WSR-57. This means the WSR-88D provides twice the azimuthal resolution of the WSR-57, allowing for better observations of storm-scale features. An example of the output from the WSR-88D is shown in figure 20 and output from the WSR-57 archive tape is in figure 21. As can be seen from the figures, the WSR-88D reflectivity image provides much more detail than the WSR-57.

Since Andover is located about 140 nm north of the Oklahoma City radar site, the velocity pattern associated with this storm was not available on the WSR-88D. However, when the tornado struck Andover, the reflectivity field indicated an intense storm with reflectivities greater than 50 dBZe (equivalent reflectivity). When this same storm was located farther southwest in Harper County, Kansas, or about 120 nm northwest of the radar site, the Doppler velocities indicated a strong mesocyclone was associated with the storm. The presence of a mesocyclone, a strong cyclonic circulation, in a thunderstorm is another good indication of possible tornadic activity. These circulations can only be observed with Doppler radar.

The supercell moving over Cowley County was also evident on the Oklahoma City WSR-88D. The WSR-88D velocities indicated a mesocyclone with the Cowley County storm at 6:33 p.m., approximately the same time a tornado touched down (6:30 p.m.) in Cowley County. This thunderstorm was about 110 nm away from the Oklahoma radar site.

The WSR-88D velocity and reflectivity fields suggested that supercells in northern Oklahoma were also tornadic. The storms, which were between 60 and 125 nm away, displayed large hook echoes in the reflectivity patterns. This hook echo signature was not evident on the radar film from Wichita, even though the storm was about the same distance from the Wichita and Oklahoma City radars. WSR-88D mesocyclone algorithm triggered mesocyclone signatures for both storms in northern Oklahoma.

The data from the Oklahoma WSR-88D was not available to WSO Wichita

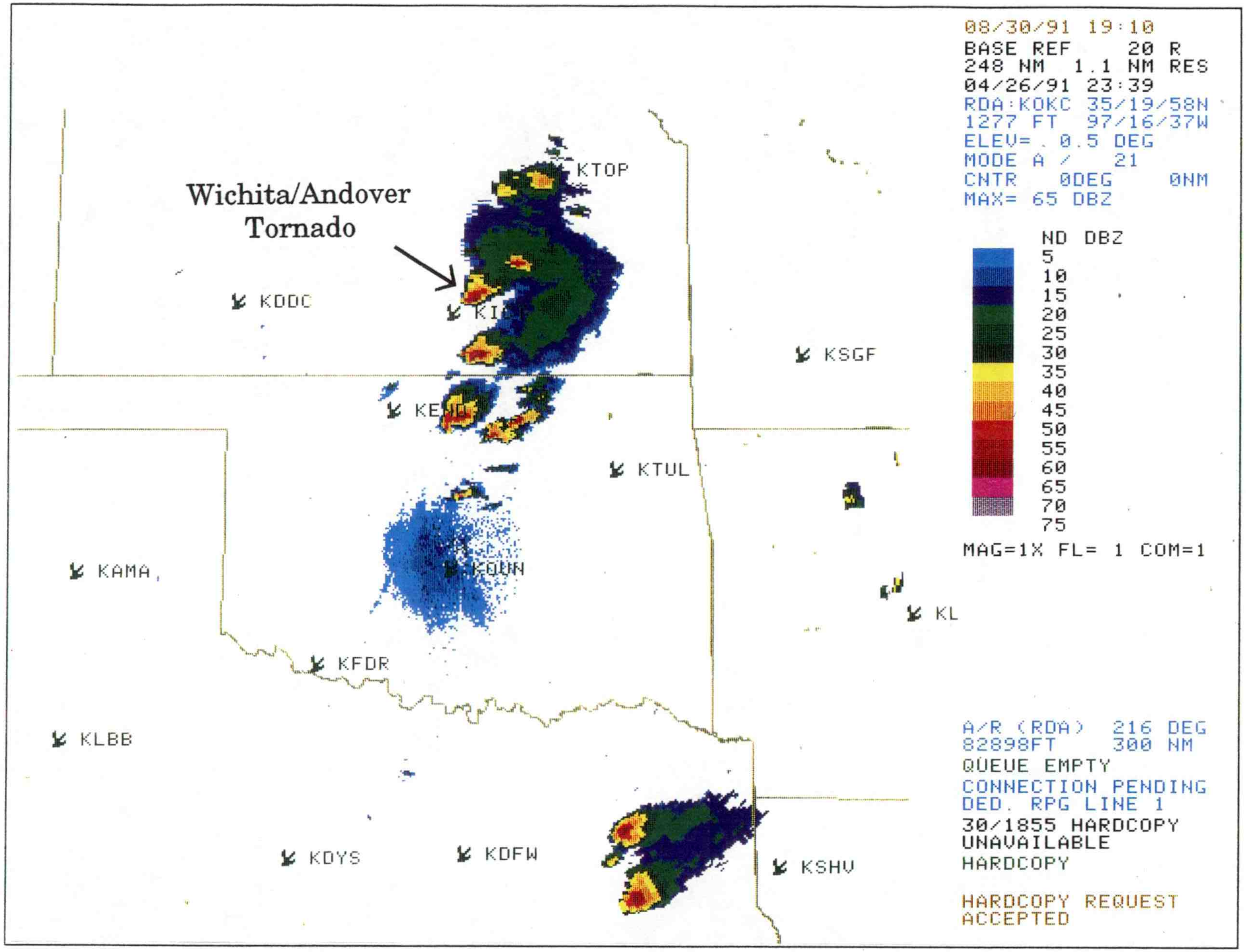


Figure 20. Color hardcopy of the Norman, Oklahoma, WSR-88D reflectivity data taken directly from the display screen. The time of the image is 2339 UTC, approximately the same time the tornado struck Andover, Kansas.

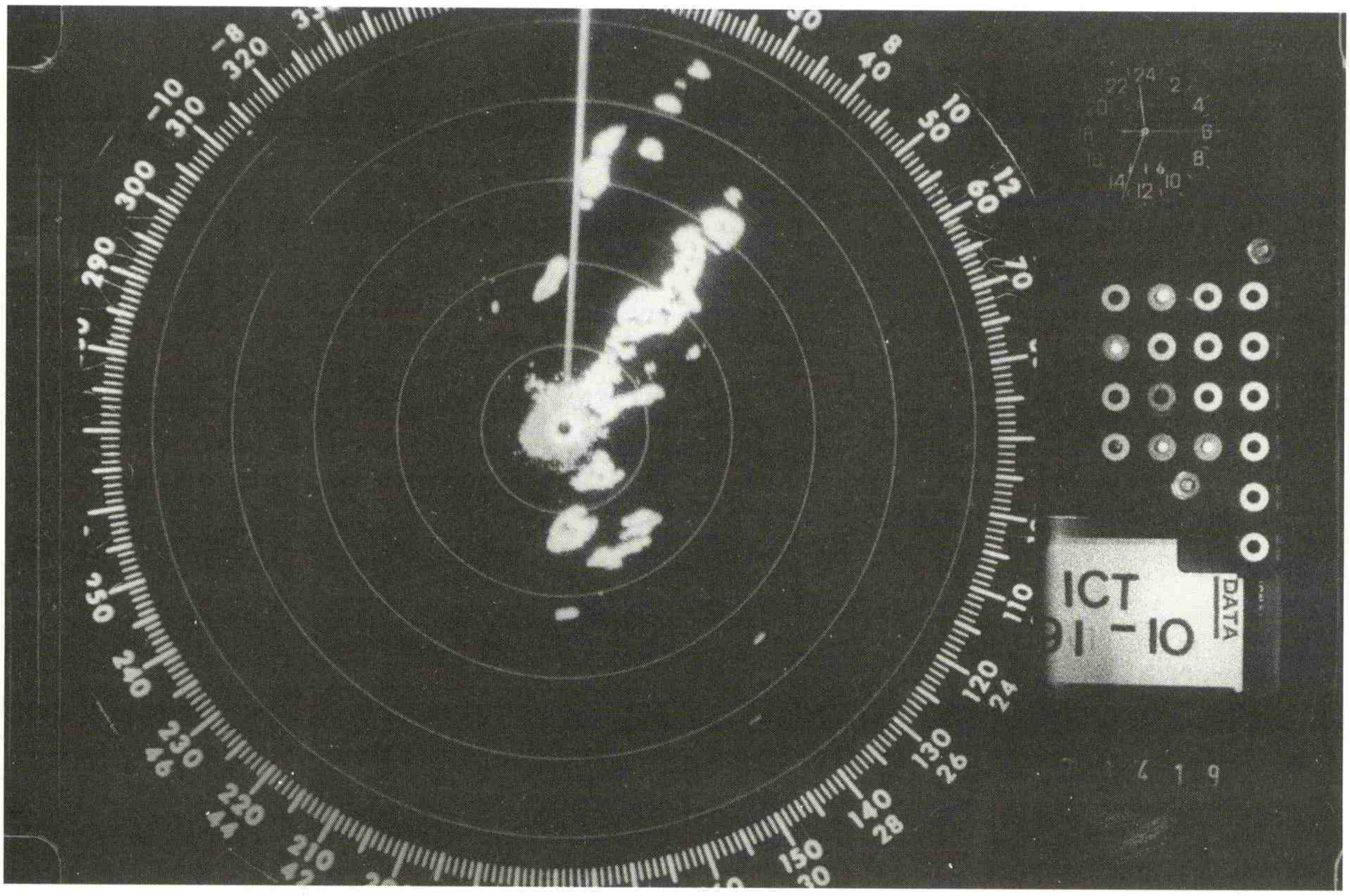


Figure 21. Photograph of the Wichita, Kansas, WSR-57 radar PPI scope at 2333 UTC, 6 minutes before the WSR-88D image in figure 20. Note how the thunderstorm that produced the Wichita/Andover tornado is masked by the ground clutter pattern.

staff. Data from the WSR-88D was used in the post-analysis of the tornado outbreak to reconstruct the event and was not used to issue warnings or statements for Kansas.

Finding 4.1: Examination of the Wichita WSR-57 and Oklahoma City WSR-88D data revealed that storm-scale reflectivity features were observed with more detail on the WSR-88D than the Wichita radar due to better azimuthal resolution. The WSR-88D storm relative velocity data and mesocyclone algorithm provided timely and highly detailed information on the storm-scale rotation to help locate the most intense and potentially tornadic storms.

Recommendation 4.1: The NWS should continue to implement the Next Generation Radar (NEXRAD) network across the Nation. This event illustrates the usefulness of the WSR-88D velocity fields and better azimuthal resolution reflectivity data.

Finding 4.2: The archive film of the Network WSR-57 Radar at WSO Wichita remained on the 250 nm range setting for the duration of the storm. The record film of the event is accordingly very difficult to analyze and cannot be used as a research tool.

Recommendation 4.2: Whenever possible during severe weather events, the archive screen of NWS radars should be switched to the 125 nm range. This information will be useful for local staff case studies as well as research quality recorded data.

Aerial photograph of damaged homes in the Springdale Subdivision southwest of Andover. Photograph courtesy of Brian Smith, NSSFC.

CHAPTER 5

PREPAREDNESS

The primary mission of the NWS is the issuance of watches and warnings to protect life and property. It is not sufficient to simply issue warnings to the public; citizens must know what to do once the warning has been issued. The NWS is only one member of the hazards community which consists of all organizations involved in the warning process. These organizations include Federal, state, and local agencies; emergency managers; elected officials; the media; volunteer groups; and private sector meteorologists. Educating the public to the hazards of severe weather is a vital part of the lifesaving mission of the NWS.

The NWS recognizes the need to educate the public and the hazards community and performs this service through preparedness. Preparedness activities include recommending safety actions to be taken during severe weather events. Local NWS offices also manage extensive spotter training and preparedness programs to educate emergency management officials and the public to the hazards of severe weather.

The NWS is by no means alone in its preparedness efforts. The entire hazards community in the Plains of the United States is particularly sensitive to the threat of severe weather. Counties in south-central Kansas have extensive community preparedness plans to address severe weather and tornado events. The combined preparedness effort was well rewarded in the Wichita area. Of all those interviewed, nearly everyone affected by the Wichita/Andover tornado was aware of the warning and knew which safety actions to take.

NWS WSO Wichita Preparedness Activities

WSO Wichita has an active internal and external preparedness program. Internally, the office completed three severe weather operations drills during January and February 1991. These drills reviewed severe weather procedures, radar identification techniques, message composition, and dissemination. All employees on station completed the drills successfully. In addition, each Wednesday the NWR tone alert test is done live to ensure proficiency in providing live broadcasts during severe weather situations. The office switches to emergency power each Thursday to ensure proficiency in that task and to check the status of the emergency generator. The office staff was well prepared to handle the severe weather situation.

Comprehensive external tornado preparedness was also accomplished

during the past year. The Wichita MIC conducted numerous spotter training and/or preparedness meetings reaching all 22 counties in the WSO Wichita CWA area from January 1991 to April 1991 (see appendix F for a complete list of spotter training and preparedness meetings). The MIC felt that the office staff should become more involved in the external preparedness program, and this year each staff member accompanied him on at least one county preparedness visit.

The publicity of the Hesston tornado in the spring of 1990 heightened tornado awareness for the 1991 season in WSO Wichita's area of warning responsibility. Due to this increased awareness, attendance at preparedness meetings this year was higher than usual. The Wichita MIC presented spotter training to all of the Sedgwick County Sheriff officers at a specially scheduled session in early April 1991. Spotter training was also given to the McConnell Air Force Base Weather Detachment in late March 1991.

Due to the high incidence of tornadoes in Kansas, spotter networks and tornado preparedness have historically been an important part of the preparedness efforts of WSO Wichita. The spotter network in the WSO Wichita warning area is excellent. During the April 26 tornado event, the office logged over 100 spotter reports. Many severe thunderstorm warnings and all tornado warnings were issued based on the spotter reports. These reports were vital as the path of the Wichita/Andover tornado moved into the ground clutter of the Wichita radar. The spotter sightings allowed personnel in the Wichita office to closely track the progression of the tornadoes in the area.

During severe weather events, ham radio operators staff a base station in the Wichita WSO to receive reports and manage the spotter network. This arrangement works exceptionally well in the immediate Wichita area, however, there are no provisions for radio relay of spotter reports from outlying counties. Reporting networks in outlying counties report to a central location in each county which then telephones reports into the Wichita office. The one phone line used for severe weather reports is currently inadequate. However, additional phone lines would not alleviate this problem. One more phone line would not double the answered calls due to limited staffing. Any arrangement using phone lines is prone to break down during severe weather situations when telephone communications are frequently interrupted.

External preparedness efforts by WSO Wichita and the local media undoubtedly saved lives and reduced injuries during the storm. The Wichita staff conducted several safety talks in the area and provided safety information to schools. Interviews with victims of the storm showed that most people knew which safety actions to take when the tornado struck. The efforts of the Wichita office and strong emphasis on severe weather safety by the local news media played a crucial role in the high level of tornado preparedness by the general public.

Community Preparedness Activities

All of the counties in the Wichita area have some form of local emergency operations plan. Most of the counties that were surveyed have plans that address detailed severe weather actions, including interaction with WSO Wichita. These plans were instrumental in guiding the response of local officials during the severe weather outbreak of April 26. Butler, Cowley, Harvey, and Sedgwick Counties have severe weather spotters who work with local officials to monitor severe weather in their counties. Some of these spotter networks coordinate directly with WSO Wichita.

Sedgwick, Cowley, and Harvey Counties have detailed severe weather communication plans designed to facilitate interactive sharing of information within their county, across counties, and with Federal and state agencies. Butler County is in the process of reviewing and revising its severe weather communication plan.

All of the counties affected by these tornadoes had participated in severe weather spotter training conducted by NWS staff during March and April. Local officials commented on the responsiveness of NWS staff to their local needs for spotter training and a closer working relationship.

County emergency management officials monitored weather forecasts for several days before the April 26 tornadoes. Many of them were aware of NWS forecasts (NSSFC) for Friday's potential severe weather as early as Thursday, April 25. Local officials recalled watching local and national cable television weather forecasts the night of April 25, highlighting the potential for severe weather. Three of the four local Emergency Operations Centers (EOC) that were surveyed were partially or fully staffed during the morning of April 26 in anticipation of the severe weather that was forecast to develop later that day.

Severe weather spotter networks were activated during the day as the weather in Oklahoma and south-central Kansas worsened. On the afternoon of April 26, both RACES and CREST volunteers arrived at WSO Wichita at 5:15 p.m. to staff the base station of the amateur radio communications network. These groups provided critical communication and spotter resources for the WSO during the tornado event. Their actions provided warning lead time that doubtlessly saved lives. Another spotter group, the Cowley County Emergency Auxiliary, actively tracked a different tornado in Cowley County and provided vital information for the NWS to issue timely warnings that allowed people in the path of that tornado to take appropriate safety actions.

All of the counties monitor local government radio traffic concerning severe weather from adjacent counties. This provides storm track information and lead time before impact in their counties. They also actively provide information to neighboring jurisdictions. Cowley County officials

actively monitor radio communication from nearby counties in both Kansas and Oklahoma. This provides them with additional information as the storms build and move toward their county.

County officials in the survey area receive NWS warning and forecast products via the ASTRA Law Enforcement Communications Circuit run by the KHP. ASTRA receives NWS information through the NWWS. The product headers are scanned by the computer which forwards all special weather statements, severe weather statements, watches, and warnings for any part of Kansas and automatically transmits the products to all terminals. This occurs in a matter of seconds. These terminals are located in local sheriff's offices and police communications centers.

All of the counties' EOCs use NWR as a source of NWS forecasts. Officials indicated that it is monitored during severe weather. However, only two of the counties have drops on NWWS. In addition, several of the counties monitor local and national television channels for coverage of the severe weather. This includes forecasts, weather reports, and radar images of storms.

User Response

When tornado warnings are issued, emergency agencies that have a responsibility to warn the public generally notify other response agencies. Those counties with outdoor warning sirens in populated areas activate them when notified of a tornado warning for their area. Towns and cities also set off their sirens to alert the public of the imminent danger. All these procedures were followed on April 26. A warning siren in Andover failed to sound. The local police department recognized the danger and sent patrol cars to drive through areas in the path of the storm to alert residents of an impending danger. One patrolman drove through the Golden Spur Mobile Home Park minutes before it was flattened by the tornado. Some counties even sent officials to isolated residents or areas to warn the citizens of the severe weather. Unfortunately, some of those personally warned individuals failed to heed the warning.

Cowley and Harvey Counties have local alerting radio systems that can communicate with numerous local emergency response officials at one time. This allowed the severe weather information to be disseminated rapidly to local officials.

Finding 5.1: There was a high level of tornado preparedness and hazard awareness in the Wichita area. Good cooperation between the media and the NWS provided ample severe weather safety rule information to the general public. Victims in the path of the tornado who were interviewed by the survey team knew which appropriate safety precautions to take.

Finding 5.2: The spotter network for the Wichita office is extensive and provided a large number of storm reports on April 26. This directly

translated into more effective warning services and lives saved. The spotter network is especially comprehensive in the Wichita and Cowley County areas with the use of the local volunteer spotter groups. However, the ability to get spotter reports from the outlying counties to the Wichita office is a problem. A single phone line to field spotter reports is insufficient.

Recommendation 5.2: The Wichita office should investigate the feasibility of establishing radio links to outlying counties via repeaters. The NWS should explore ways to obtain funding support for repeater networks to expand the ham and amateur radio operator spotter coverage.

Finding 5.3: All Wichita staff members attended at least one spotter training and/or preparedness meeting with external users during the spring of 1991. As a result of this interaction, the staff was aware of how their products are used and what is expected of them by the external users.

Recommendation 5.3: All Wichita staff responsible for issuing warnings should continue to be involved in the spotter training and/or preparedness meetings. The NWS should continue to encourage this practice at all NWS field offices.

Finding 5.4: Staff from WSO Wichita visited all 22 counties in their county warning area during the spring of 1991. Spotter training sessions were conducted in all counties. This type of contact fosters increased local preparedness. Local officials indicated that the training was a positive factor in their response prior to and during this event.

Finding 5.5: Many local officials are oriented toward proactive behavior during severe weather. They believe that appropriate warning behavior can save lives.

Closeup of F4-F5 damage. Photograph courtesy of Paul Bowen.

CHAPTER 6

DISSEMINATION AND COMMUNICATION

WSO Wichita is responsible for severe weather warning dissemination in their CWA which is comprised of 22 counties in southeast Kansas. During severe weather warning episodes, WSO Wichita utilizes multiple mass dissemination systems to distribute NWS warnings to local emergency officials and the public. The use of mass dissemination systems is encouraged so NWS warnings can be disseminated to the greatest number of interested parties with the most efficient use of limited personnel resources. During the April 26 Wichita area tornado outbreak, all of the mass dissemination systems, except for the Emergency Broadcast System (EBS), available to the office were utilized effectively. Aside from the power outage at the office for approximately 10 minutes near 6:45 p.m., all communication systems were operational and all messages were appropriately transmitted.

WSO Wichita uses the internal NWS AFOS network to issue warnings and statements. Examination of records obtained from logs of the controllers at the AFOS System Monitoring and Coordination Center indicated that the AFOS network was fully operational during the afternoon and evening of April 26. Minor AFOS system crashes at approximately 6:19 p.m. and 6:44 p.m. were likely the result of voltage fluctuations in the commercial power that supported the office. These brief outages did not affect the issuance of any of the warnings or statements that included Sedgwick and Butler Counties.

The staff at WSO Wichita use an IBM compatible personal computer (PC) to streamline the issuance of tornado and severe thunderstorm warnings and statements by using an application program called SRWARN. Early in the afternoon, there were minor problems using the PC and SRWARN, but no delays were encountered for issuing warnings and statements for the Wichita/Andover tornado. It is not known if these minor problems were hardware, software, or operator-related difficulties.

NOAA Weather Wire Service (NWWS)

Warnings and statements issued by WSO Wichita are transmitted via the AFOS network to WSFO Topeka where they are uplinked to the NWWS. All of the warnings and statements issued by Wichita on the afternoon of April 26 were disseminated on the NWWS (see appendix G for the WSFO Topeka NWWS message log). While the three network television affiliates in Wichita are subscribers to the NWWS, no Wichita radio stations subscribe to the

subscribers in Kansas. The KHP receives NWS warnings via the NWWS and relays the warnings to local police agencies via the ASTRA circuit.

NOAA Weather Radio (NWR)

WSO Wichita provides programming for two NWR transmitters via two programming consoles. NWR station KEC-59, located in Wichita, broadcasts on a frequency of 162.55 MHz (megahertz). This station serves the following south-central Kansas counties: Reno, Harvey, Butler, Kingman, Sedgwick, Cowley, Sumner and Harper. NWR station WXK-95 located near Chanute, Kansas, broadcasts on a frequency of 162.40 MHz and serves the following southeast Kansas counties: Woodson, Allen, Bourbon, Crawford, Cherokee, Labette, Montgomery, Wilson and Neosho. However, NWR coverage is not complete in all of these counties, leaving many holes in the coverage.

Severe weather warnings issued by WSO Wichita are broadcast live on NWR and are preceded by the warning tone alarm. The warning message is also taped and included in the broadcast cycle until the warning is no longer valid. The area affected by the April 26 tornadoes is covered by NWR station KEC-59. Interviews with the station MIC and WSO staff on duty during the Andover tornado indicated that all warnings and statements for the area were broadcast in a timely fashion. However, the broadcast log for April 26 was incomplete, making it difficult to document the exact time each warning and/or statement was broadcast. Since there were no complaints of missing or delayed warning information by NWR users, particularly the emergency management community, it appears that adequate, timely information was disseminated.

During the tornado event, power to the NWR transmitter was lost and NWR output dropped from 1 kilowatt to 100 watts. Local radio stations were still able to pick up the signal and rebroadcast the NWS message.

Many of the emergency services agencies in the Wichita area use NWR as a primary means of receiving severe weather information. The NWR is used to a much lesser degree by the local radio and television stations. At the electronic media outlets which have NWR receivers, the NWR is usually a backup system for receipt of severe weather information. In field interviews with residents directly impacted by the tornadoes, the survey team was unable to locate anyone who had received severe weather information via NWR.

ASTRA Law Enforcement Communications Circuit

The KHP drives the statewide ASTRA law enforcement computer communications circuit. The KHP computer captures severe weather warnings and statements off the NWWS and immediately transmits them on the ASTRA circuit. The NWS products are printed on a terminal at each ASTRA drop in the state. Most local and county law enforcement

agency offices have drops on the ASTRA circuit. The ASTRA dissemination of NWS products on April 26 functioned effectively. All EOCs were on the ASTRA circuit; however, the Andover Police Department was not.

National Warning System (NAWAS)

NAWAS is a voice warning dissemination system in Kansas. The NAWAS telephone hotline links various governmental and law enforcement agencies. Warnings are read over the NAWAS by WSO Wichita personnel. The NAWAS was used in dissemination of warnings on April 26 and functioned effectively.

Local Media

Most of the local radio and television outlets in Wichita are very adept at providing information to the public during severe weather situations. All television stations have staff meteorologists and receive NWS warnings and statements via the NWWS. During the April 26 tornado outbreak, all of the major television stations either pre-empted routine programming to provide continuous live coverage of the severe weather event or had frequent message crawls and special bulletins providing severe weather updates. The three major television network affiliates all have their own spotter networks to provide additional information. All local television stations provided excellent information about the severe weather outbreak. Local radio and television stations, quoting strongly worded NWS messages from NSSFC, began alerting the public to the potential danger of severe weather on April 26, 2 days before the tornadic event.

Local cable television is also used extensively by the EOCs. During severe weather days, most of the EOCs actively monitor cable broadcasts of The Weather Channel (TWC). TWC is a private company that provides continuous weather information via cable television. TWC rebroadcasts NWS watches, warnings, and special and severe weather statements. To highlight the important messages from the NWS, TWC scrolls the actual NWS message on the screen with either a brown background for statements or a red background for warnings. The messages are county coded allowing only the warned counties to have the appropriate color displayed on the television screen. Many EOCs turn down the sound and monitor the screen for the radar information and the red or brown background.

WSO Wichita provided training for the television and radio stations that have their own spotter networks. One television station brought 38 of their storm spotters in from across the state for a training session only 3 weeks before the Wichita/Andover tornado struck. Remote, live spotter reports helped heighten public consciousness to the impending event.

Local radio stations showed a wider variety of commitment to disseminate weather information. Some of the stations have their own spotter networks and go to live coverage of

severe weather events, while other stations remain in routine format and provide only limited severe weather information. At the request of one of the stations, the Wichita MIC made recordings of safety messages that would be used during the appropriate weather event. The aggressive weather reporting stations are well known to residents in the Wichita area, and many residents switch to those stations when severe weather threatens. These weather-conscious stations provided excellent information during this severe weather episode.

The news director of a leading Wichita radio station reported that he attached a live microphone to the loudspeaker of his NWR. (The NWR broadcasts continued throughout the event, even after the tornado hit the transmitter, cutting power from 1 kilowatt to 100 watts.) During the storm, his station was operating in accordance with a 9-page guideline he had drafted for station personnel titled "Severe Storm Programming."

The team interviewed approximately 50 residents in the tornado damaged areas. These individuals stated that they first heard the tornado warnings on commercial radio or television. Abundant severe weather information was available to the Wichita area residents via the electronic media throughout the tornado event.

While the "short time fuse" of thunderstorms and tornadoes makes it impossible for a newspaper to be part of the real-time alert system, Wichita's morning newspaper assisted with long-term public awareness by devoting many pages of the April 27 and following issues to photos and text reporting the human and property impact of the storm. Local television stations in the Wichita area were hyping the event days before it occurred, but the newspapers had no products describing the potential for the severe weather. Editors requested that in the future, the NWS produce a product highlighting the potential for severe weather the day before the event was expected.

While in Kansas, the survey team interviewed numerous local newspaper, radio, and television personnel to assess the impact of the event and determine the efforts of the media in the warning process. Wichita area media managers, weathercasters, and news personnel were uniformly pleased with the timeliness and accuracy of information provided to them by the NWS. Many stations rely solely on NWS bulletins and mentioned the need for more bulletins during the height of the storm. Other comments focused on continuing the public education efforts and promoting NWR.

Emergency Broadcast System (EBS)

In general, the EBS in southeast Kansas is not activated for severe weather warnings. The electronic media rely on other systems to obtain severe weather warnings. In keeping with the area EBS policy, KFH, the Central Program Control Station (CPCS-1), did not activate the EBS during the April 26 severe weather

episode. It is state policy for the primary EBS station to activate first with secondary stations following. It is also state policy for the EBS not to be activated for tornado, severe thunderstorm, or flash flood warnings.

News Wire Services

Associated Press and United Press International news wire services that are available to the Wichita media relay NWS warnings and statements to their subscribers. This is the primary way that many radio stations receive this information. The news wire services receive information which has been transmitted via AFOS into the NWS Gateway communications system for relay to external users. During the April 26 severe weather event, there were no apparent breakdowns in this dissemination system.

Finding 6.1: NWS dissemination systems operated efficiently with all warnings and statements being disseminated in a timely fashion. It appears that NWR dissemination was complete; however, incomplete broadcast logs made this difficult to determine.

Recommendation 6.1: WSO Wichita should develop streamlined but comprehensive procedures for completing the NWR broadcast log during severe, or other non-routine, weather situations.

Finding 6.2: The general public interviewed by the survey team did not use NWR as a source of weather information. They relied on commercial radio and television. The electronic media, in general, use NWR as a backup source of severe weather information, and not all radio stations have NWR receivers. Emergency management agencies used NWR as a primary source of severe weather information.

Recommendation 6.2: Promote the use of NWR in preparedness and spotter presentations. The NWS should increase public education about the NWR system. This valuable warning service is being overlooked by the general public in the Wichita area. NWR is particularly useful with the NWR Specific Area Message Encoder (WRSAME). WRSAME automatically transmits a short code before (and after) messages heard over NWR. The code specifically identifies the type of weather hazard and the counties that are threatened or affected. A companion decoder device allows users to select which messages they want disseminated, saved, etc. NWS should continue the implementation of WRSAME.

Finding 6.3: The local media provided excellent dissemination of severe weather information during this episode. With the history of severe weather occurrence in southeast Kansas, the local media has developed extensive plans to gather and disseminate severe weather information over the air. The continual live television coverage of the developing weather situation was cited by several people as a lifesaving source of

information and warnings. While abundant severe weather information was available via the electronic media, there were some stations with a lower priority on disseminating weather information during the tornado outbreak. Residents in the Wichita area are knowledgeable about which stations to tune to when severe weather threatens.

Finding 6.4: The EBS was not activated during the April 26 tornadoes in the Wichita area. This was not an oversight or breakdown, rather it is standard operating procedure. The southeast Kansas EBS is not activated for severe weather warnings. This seems to be the standard throughout the state of Kansas.

Recommendation 6.4: While the EBS is operated different ways in different parts of the country, FEMA should review EBS operating procedures in Kansas with an eye toward activation for tornado warnings and flash flood warnings. Activation of the EBS for tornado warnings may get more severe weather information onto radio stations which normally have a lower priority for broadcasting severe weather information. Local NWS offices should coordinate with the primary EBS station in its CWA.

Finding 6.5: Local officials had multiple sources of severe weather forecasts put out by the NWS (i.e., local and national television as well as NWS statements). Some local officials also indicated the need for a product that provides updated information between a tornado watch and a tornado warning.

Recommendation 6.5: WSFOs and WSOs should educate the user community about the uses of SPS and severe weather statement (SVS). These messages contain updated information between the watch and warning. NWS should explore a routine, timed issuance (perhaps every 30 or 60 minutes) of the SPS or SVS during severe weather events to keep the emergency management community (EMC) informed of the situation.

Finding 6.6: Local newspapers cannot respond to short-fused warnings or watches. Local newspapers would like to see an outlook-type statement the afternoon before severe weather is expected.

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situations allowing for such forecast reliability more than 24 hours in advance are rare. However, all efforts should be made to communicate the potential severity of the event to the public as far in advance as possible.

Finding 6.7: NWR coverage is incomplete in the Wichita WSO CWA.

Recommendation 6.7: NWS should explore ways to provide complete NWR coverage throughout all WSO Wichita's CWA. If NWS staff promotes NWR during its preparedness efforts, the user community must be able to receive the NWR signal.

Photograph of a vehicle in a field 1/2 to 3/4 mile northeast of the Golden Spur Mobile Home Park. The vehicle was so badly damaged it was not determined whether it was a car or a truck. It is believed that this vehicle was from the mobile home park.

Photograph of the Cowley County tornado on the ground northeast of Winfield, Kansas. This tornado was rated F4. Photograph courtesy of Susie Light.

CHAPTER 7

PUBLIC RESPONSE

Team members interviewed approximately 50 tornado victims in the Oaklawn and Andover areas. The team was unable to interview any residents of the mobile home park in Andover since cleanup was nearing completion and the victims were not around when the team arrived. The comments from all of the people interviewed shared a common theme. In most cases, the victims received a warning via commercial television, radio, or an outdoor siren. This was not sufficient information to have the people seek shelter. They needed to personally assess their own risk. Once they had the confirmation they needed, usually visual, the victims knew the NWS tornado safety rules and what safety actions to take.

Most victims first received the warning via their television. Fewer people received the warning through commercial radio broadcasts. All victims interviewed in the Oaklawn area, south-southeast of Wichita, also heard tornado warning sirens. Some heard them about the same time they received the warning on television, while others heard the sirens when they went outside to confirm the threat. In Andover, where the outdoor warning siren failed, several people reported hearing a police car driving around with its siren sounding. None of the victims interviewed reported receiving the warning on NWR. None of the people interviewed owned an NWR receiver, and there was a lack of knowledge about the service.

Nearly every victim interviewed sought visual confirmation of the tornado before they moved to a safe area. People reported that when they heard the warning they went outside to look for the storm. Many witnesses watched the tornado for 5 to 10 minutes before going to a safe location. In most instances, the storm was visible 5 to 10 miles away. Due to the high visibility in the area where the storm struck, this phenomena did not substantially increase the number of deaths or injuries. In other areas of the country (or at night) where heavy rain and low clouds frequently obscure tornadoes, this delayed reaction could have produced a substantial increase in the number of deaths and/or injuries.

Many of the fatalities in the Wichita/ Andover tornado occurred in the Golden Spur Mobile Home Park. The park contained 241 mobile homes and approximately 700 residents. Information from media reports indicated that most residents of the park sought shelter by either leaving the park or by going to the storm shelter located in the mobile home park. The team estimated that the shelter could hold approximately 300 people huddled close together. Local estimates indicated that 200 people

sought refuge in the storm shelter at the mobile home park when the tornado struck. Eyewitness reports relayed to the team from local NWS and emergency management officials indicated that many people lingered outside the shelter until the tornado was bearing down on the mobile home park. This left precious little time to get safely into the shelter.

The tornado victims were very knowledgeable about general tornado safety rules and actions. Every person interviewed knew where the safest location in their home was located. People with basements went to that area to seek shelter, mostly under a table or workbench. If the home did not have a basement, people went to an interior hallway or bathroom. Several victims reported that they pulled mattresses on top of their families to provide extra protection. When the victims were queried about how they knew what safety precautions to take, most of them stated that they received safety information through their school-aged children. Those who did not get their safety information through children stated that they read safety rules in local newspapers.

Many families in the Wichita area are two-wage earner families. This creates the need for many children to be home alone once school is finished for the day. The following story recounts the experience of one such latchkey family and illustrates the value of teaching tornado safety rules in schools.

"Latchkey" kids were called by their dad and told to watch out for the severe weather. They went into the basement and watched television. They ordered pizza for dinner and awaited their dinner in the basement. The pizza delivery person arrived, so they figured if an adult is outside, it must be okay outside. They moved upstairs to the kitchen and continued to watch television while they ate the pizza. On television they saw that there was a nice rainbow outside so they went outside to see it. Once outside, they saw the tornado headed straight toward them. They rounded up the cats and dogs and went to the basement...not in the basement family room which has windows and is where Mom and Dad take them during tornado drills. Instead, they went inside the laundry room (small interior room with no windows) and got under the sink...just like they learned in school. The house sustained a direct hit and was leveled by the tornado! The family room was filled with debris and broken glass. Fortunately, the kids were in the interior room and they escaped certain injury they would have sustained had they remained in the family room. The kids were fine. The interior basement room had no damage.

Finding 7.1: A substantial number of the victims interviewed received warning of the tornado before it struck, usually through television or commercial radio. Oaklawn residents did hear the outdoor warning sirens which heightened their awareness of the threat. In the Andover area, the local outdoor warning siren failed. Local police recognized the problem and immediately drove patrol cars

through the town streets sounding the sirens to warn residents of the impending tornado.

Finding 7.2: Based upon survey team field interviews, a majority of the people affected by the storm needed visual confirmation of the tornado before taking protective action. Hearing the tornado warning on television or radio was not sufficient. They needed to assess their own risk of the situation and ventured outside to look for the tornado.

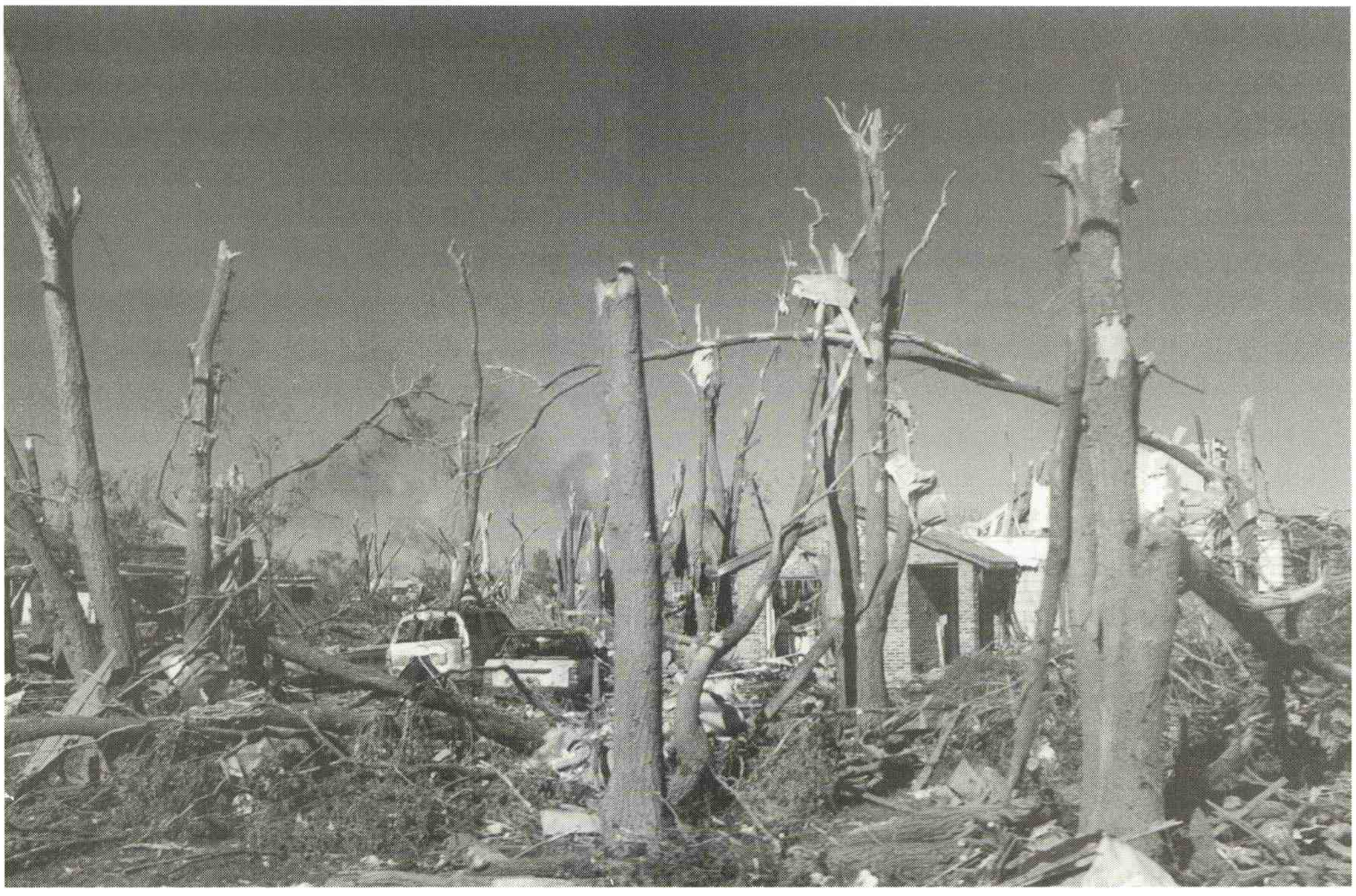
Recommendation 7.2: NWS should continue to provide frequent and detailed warnings and statements specifically mentioning cities or locations in the path of the storm. This may allow people to better assess their own risk and move more quickly to a safer location.

Finding 7.3: All of the victims who were interviewed knew where the tornado-safe areas were in their location.

Finding 7.4: Tornado safety information reached the public through school preparedness efforts.

Recommendation 7.4a: Efforts by the NWS and local emergency management agencies should continue to stress severe weather safety education in schools.

Recommendation 7.4b: Success stories from this event should be incorporated into NWS preparedness materials.



Photograph of the Greenwich Heights Subdivision northeast of McConnell Air Force Base illustrating F3- to F4-type damage. Photograph courtesy of John Sokich, NWS.

Photograph of garden hand spade embedded in a tree. There is also a tack stuck in the tree to the top and left of the spade. Photograph courtesy of John Sokich, NWS.

CHAPTER 8

CONCLUSION: FINDINGS AND RECOMMENDATIONS

This event, tragic as it was, illustrates the positive effects the preparedness efforts and warning system can have on the population. The entire warning community spoke with one voice to notify the public of the approaching tornado. Numerous media, both television and radio, provided extensive coverage and virtually immediate dissemination of NWS warnings and information. Without this effort, the loss of life would have been more extensive.

Although the system worked well, room for improvement remains. The following summary of the "Findings and Recommendations" recognizes the areas for improvements in the complete warning process from preparedness to public response.

Findings and Recommendations

Finding 1.1: The Wichita/Andover tornado was one of four tornadoes spawned from a supercell that tracked from north-central Oklahoma across south-central Kansas into eastern Kansas before weakening. There were other strong tornadoes in Kansas and Oklahoma from different thunderstorms, but these tornadoes tracked mostly across rural areas.

Finding 1.2a: An NSSFC meteorologist trained in aerial damage survey techniques conducted an aerial damage survey to examine the tornado track. The survey was conducted 5 days after the tornado, long after many of the areas had been cleaned up. Most of the destroyed homes and buildings were already removed making it difficult to ascertain the exact strength of the tornado. Fortunately, aerial photos were obtained that had been taken on the morning of April 27, the day after the storm. The damage in these pictures supported a tornado intensity rating of F5.

Finding 1.2b: The Wichita/Andover tornado was surveyed in detail and much important data has been obtained from the aerial survey. However, the opportunity to gather more tornado research data covering the remainder of this multiple state tornado outbreak was lost. The Operational Support Facility in Norman would also have greatly benefited from an aerial survey of the entire outbreak over Oklahoma.

Recommendation 1.2: Establish the capability to conduct quick response aerial and ground surveys after all significant (F4 or F5) tornadic events. Surveys are necessary whenever there is severe damage or significant loss of life resulting from significant tornadic events. Timely tornado surveys are also needed to obtain data for tornado research and Storm Data. Detailed analyses of aerial data will provide

invaluable information as the results are compared to what is observed in the WSR-88D velocity data, reflectivity data, and all derived products.

Finding 2.1: The synoptic weather situation that occurred on Friday, April 26, was a classic tornado outbreak pattern.

Finding 2.2: The 3 km helicity values were supportive of violent tornadic formation.

Finding 2.3: Satellite information available at the NCs is far superior to that which is currently available at WSFOs or WSOs. The digital data available on the VDUC system dwarfs the information available on SWIS.

Recommendation 2.3: The NWS should implement its modernization plan including provision of state of the art digital satellite data to all field offices. This information is vital for forecasting initiation and dissipation of mesoscale convective events.

Finding 3.1: Synoptic scale parameters were exceptionally well forecast by the numerical models.

Finding 3.2: National Weather Service forecasters were well aware of the potential for damaging thunderstorms on Friday, April 26. As early as Thursday morning, forecasters were highlighting the potential for tornado development on Friday across the central and southern Plains.

Finding 3.3a: NSSFC provided excellent outlook and watch services for this event. The Day 2 Outlook identified the potential for tornadoes more than 37 hours in advance. PWOs issued by NSSFC provided extensive lead time and highlighted the severity of this event. Tornado Watch No. 183 was issued more than 6 hours prior to the time that the tornado moved through Andover.

Finding 3.3b: NSSFC issued a total of 24 watches on April 26. The 14 watches issued during the evening shift was a record high number for any single shift.

Finding 3.4a: WSFO Topeka followed established procedures to highlight the potential for severe weather in statements and forecasts. Products issued by WSFO Topeka were timely and informative. The wording of the ZFP follows the policy established in Weather Service Operations Manual (WSOM) Chapter C-40 "Severe Local Storm Warnings." The ZFPs issued by the Topeka WSFO did not differentiate this day from any other severe thunderstorm day.

Recommendation 3.4a: Change WSOM Chapter C-40 to encourage stronger wording in zone forecasts when "high risk" areas are outlined by NSSFC. For example, instead of "...50% CHANCE OF THUNDER-STORMS...SOME POSSIBLY SEVERE" the recommended wording could be "...SEVERE THUNDERSTORMS LIKELY...SOME MAY PRODUCE TORNADOES."

Finding 3.4b: On Thursday afternoon, April 25, WSFO Topeka recognized the potential for significant severe weather and highlighted the

potential in the internal NWS SFD product. This information was not included in the ZFP issued that same afternoon.

Recommendation 3.4b: On days when the potential for severe weather is highlighted for the next day in the SFD, the NWS should encourage use of severe weather terminology in the ZFPs issued at the same time. This may enable emergency managers to better plan staffing for the severe weather episode. Highlighting the potential of a big event will also provide the public with more advanced notification to prepare for the event.

Finding 3.5: WSFO Topeka issued SPSs to emphasize specific information on severe thunderstorm development in Kansas.

Finding 3.6: WSO Wichita provided good warning services during an extremely active severe weather outbreak. Multiple events were occurring simultaneously in Wichita's area of responsibility, yet the tornado warnings for Sedgwick and Butler Counties were timely and effective.

Finding 3.7: Severe weather occurred in 17 of 22 counties in WSO Wichita's CWA. WSO Wichita issued a total of 17 tornado warnings, 33 severe thunderstorm warnings, and 44 severe or special weather statements.

Finding 3.8: Warnings and statements issued by WSO Wichita were well written, timely, action provoking, specific, and contained appropriate call to action statements and safety rules.

Finding 3.9: All of the tornado warnings issued by WSO Wichita were based on spotter reports.

Finding 3.10: Conflicting spotter reports, which placed the tornado in different locations at the same time, introduced confusion into the warning process and into the reconstruction of the post-storm tornado track and timing.

Recommendation 3.10: Spotter training should emphasize not only proper storm identification procedures but proper reporting procedures as well, i.e., spotter reports should clearly indicate the time the observation was taken and whether the location reference is an estimate of the storm location or the spotter's location. Whenever possible, the radar film should be used to assist in the reconstruction of the post-storm tornado path and timing.

Finding 3.11: Commercial power was interrupted at WSO Wichita during the event. The staff had planned to switch to emergency power at 5:30 p.m., but by that time a tornado was already reported southwest of Wichita. Wichita's Station Duty Manual recommends switching to emergency power when thunderstorms are within 25 miles of the station.

Recommendation 3.11: When practical, consideration should be given to switching to emergency power early on days when severe weather is expected. Factors, such as the high risk outlook, the tornado watch, and available fuel supply for the emergency generator should be given consideration

in this decision. The Station Duty Manual should be worded to allow for this flexibility.

Finding 4.1: Examination of the Wichita WSR-57 and Oklahoma City WSR-88D data revealed that storm-scale reflectivity features were observed with more detail on the WSR-88D than the Wichita radar due to better azimuthal resolution. The WSR-88D storm relative velocity data and mesocyclone algorithm provided timely and highly detailed information on the storm-scale rotation to help locate the most intense and potentially tornadic storms.

Recommendation 4.1: The NWS should continue to implement the Next Generation Radar (NEXRAD) network across the Nation. This event illustrates the usefulness of the WSR-88D velocity fields and better azimuthal resolution reflectivity data.

Finding 4.2: The archive film of the Network WSR-57 Radar at WSO Wichita remained on the 250 nm range setting for the duration of the storm. The record film of the event is accordingly very difficult to analyze and cannot be used as a research tool.

Recommendation 4.2: Whenever possible during severe weather events, the archive screen of NWS radars should be switched to the 125 nm range. This information will be useful for local staff case studies as well as research quality recorded data.

Finding 5.1: There was a high level of tornado preparedness and hazard awareness in the Wichita area. Good cooperation between the media and the NWS provided ample severe weather safety rule information to the general public. Victims in the path of the tornado who were interviewed by the survey team knew which appropriate safety precautions to take.

Finding 5.2: The spotter network for the Wichita office is extensive and provided a large number of storm reports on April 26. This directly translated into more effective warning services and lives saved. The spotter network is especially comprehensive in the Wichita and Cowley County areas with the use of the local volunteer spotter groups. However, the ability to get spotter reports from the outlying counties to the Wichita office is a problem. A single phone line to field spotter reports is insufficient.

Recommendation 5.2: The Wichita office should investigate the feasibility of establishing radio links to outlying counties via repeaters. The NWS should explore ways to obtain funding support for repeater networks to expand the ham and amateur radio operator spotter coverage.

Finding 5.3: All Wichita staff members attended at least one spotter training and/or preparedness meeting with external users during the spring of 1991. As a result of this interaction, the staff was aware of how their products are used and what is expected of them by the external users.

Recommendation 5.3: All Wichita staff responsible for issuing warnings should continue to be involved in the spotter training and/or preparedness

meetings. The NWS should continue to encourage this practice at all NWS field offices.

Finding 5.4: Staff from WSO Wichita visited all 22 counties in their county warning area during the spring of 1991. Spotter training sessions were conducted in all counties. This type of contact fosters increased local preparedness. Local officials indicated that the training was a positive factor in their response prior to and during this event.

Finding 5.5: Many local officials are oriented toward proactive behavior during severe weather. They believe that appropriate warning behavior can save lives.

Finding 6.1: NWS dissemination systems operated efficiently with all warnings and statements being disseminated in a timely fashion. It appears that NWR dissemination was complete; however, incomplete broadcast logs made this difficult to determine.

Recommendation 6.1: WSO Wichita should develop streamlined but comprehensive procedures for completing the NWR broadcast log during severe, or other non-routine, weather situations.

Finding 6.2: The general public interviewed by the survey team did not use NWR as a source of weather information. They relied on commercial radio and television. The electronic media, in general, use NWR as a backup source of severe weather information, and not all radio stations have NWR receivers. Emergency management agencies used NWR as a primary source of severe weather information.

Recommendation 6.2: Promote the use of NWR in preparedness and spotter presentations. The NWS should increase public education about the NWR system. This valuable warning service is being overlooked by the general public in the Wichita area. NWR is particularly useful with the NWR Specific Area Message Encoder (WRSAME). WRSAME automatically transmits a short code before (and after) messages heard over NWR. The code specifically identifies the type of weather hazard and the counties that are threatened or affected. A companion decoder device allows users to select which messages they want disseminated, saved, etc. NWS should continue the implementation of WRSAME.

Finding 6.3: The local media provided excellent dissemination of severe weather information during this episode. With the history of severe weather occurrence in southeast Kansas, the local media has developed extensive plans to gather and disseminate severe weather information over the air. The continual live television coverage of the developing weather situation was cited by several people as a lifesaving source of information and warnings. While abundant severe weather information was available via the electronic media, there were some stations with a lower priority on disseminating weather information during the tornado outbreak. Residents in the Wichita

area are knowledgeable about which stations to tune to when severe weather threatens.

Finding 6.4: The EBS was not activated during the April 26 tornadoes in the Wichita area. This was not an oversight or breakdown, rather it is standard operating procedure. The southeast Kansas EBS is not activated for severe weather warnings. This seems to be the standard throughout the state of Kansas.

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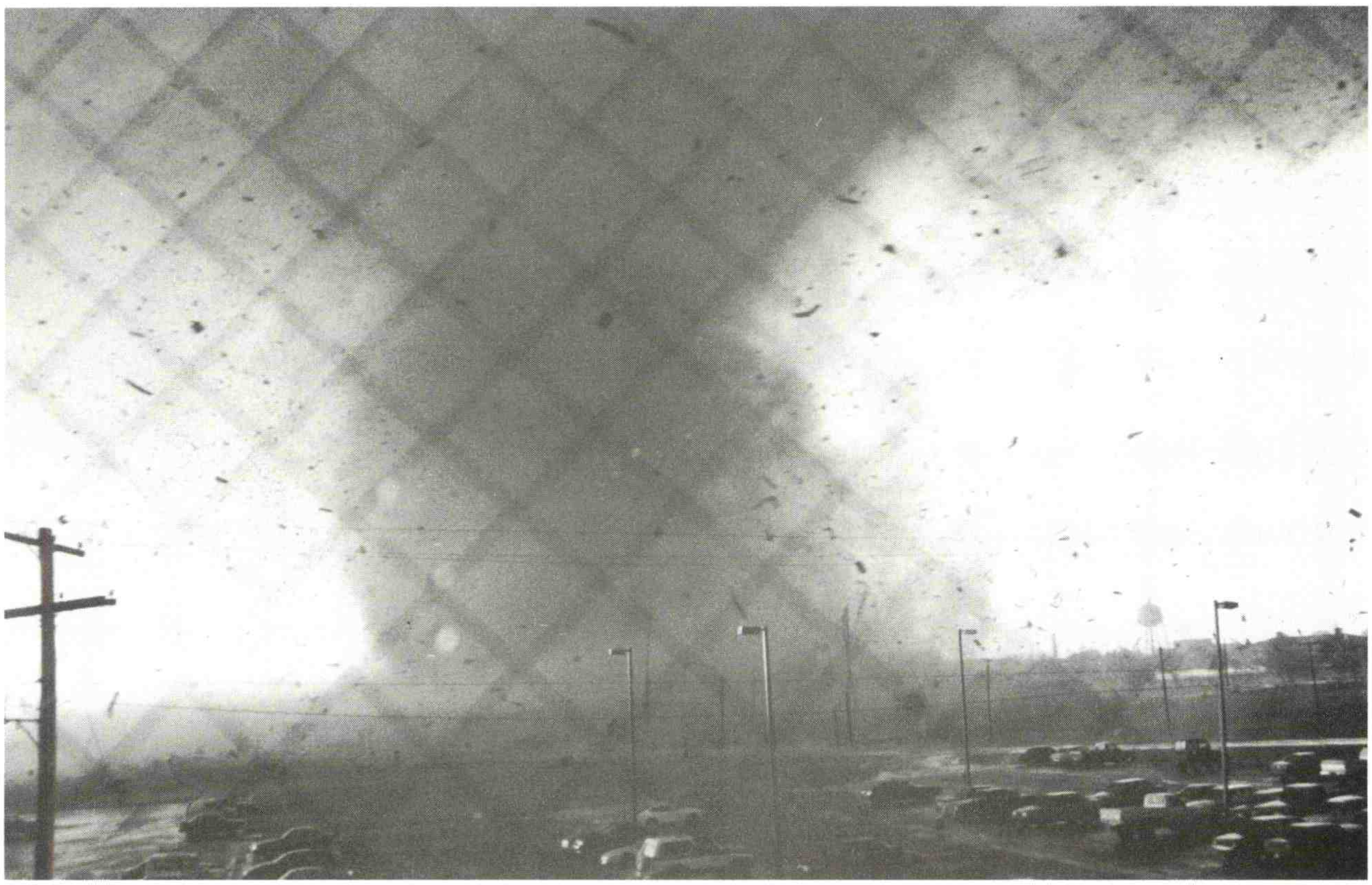
Recommendation 7.4b: Success stories from this event should be incorporated into NWS preparedness materials.

Photographs on this page and the following two pages show the tornado as it approached and moved across McConnell Air Force Base. Courtesy of A1C Daniel L. Studebaker.



APPENDIX A

LIST OF SEVERE WEATHER REPORTS

NSSFC TORNADO AND SEVERE THUNDERSTORM REPORTS
PRELIMINARY LIST - INTERNAL DISSEMINATION ONLY
FOR 06CST FRI APR 26 1991 THRU 06CST SAT APR 27 1991

	EVENT	LOCATION/REMARKS		(CST) TIME
12*	*TORN	5 NW WASHINGTON KS (35 SW BIE)	(WT# 183)	26/1439
		LRG TORNADO RPTD. XTNSV PROP DMG AT HANOVER AND 3 W WASHGTN.	CNK/TOR	3988/9713
181	*TORN	SE OHIOWA NE (37 WNW BIE)	(WT# 182)	26/1440
		4 GRAIN TRAILERS FLIPPED..BARN DSTRYD	GRI/LSR	4041 9745
18	*TORN	1 E DUNLAP KS (19 NNW EMP)	(WT# 183)	26/1515
			TOP/SVS	3858 9635
20	*TORN	5 NE COUNCIL GROVE KS (29 NNW EMP)	(WT# 183)	26/1521
			TOP/SVS	3871 9640
23	*TORN	2 S BEATRICE NE (4 S BIE)	(WT# 182)	26/1535
			LNK/TOR	4023 9673
25	*TORN	12 SW ESKRIDGE KS (27 NNW EMP)	(WT# 183)	26/1538
			TOP/TOR	3871 9628
24	*TORN	WABAUNSEE CO KS (28 ESE MHK)	(WT# 183)	26/1540
		TORNADO RPTD NR LK WABAUNSEE.	TOP/SVS	3893 9620
26	*TORN	6 SE ALM KS (28 ESE MHK)	(WT# 183)	26/1551
			TOP/SVS	3894 9620
58	*TORN	25 W TOPEKA KS (24 ESE MHK)	(WT# 183)	26/1600
		TOR RPTD NR I-70 AND HWY 99.	TOP/TOR	3905 9621
56	*TORN	7 E ANTHONY KS (39 ESE P28)	(WT# 183)	26/1615
			ICT/TOR	3714 9788
57	*TORN	NR ROSSVILLE KS (18 WNW TOP)	(WT# 187)	26/1615
			TOP/SVS	3913 9595
196	*TORN	PALMYRA NE (22 ESE LNK)	(WT# 182)	26/1634
			LNK/LSR	4069 9638
45	*TORN	NR CONWAY SPGS KS (21 SW ICT)	(WT# 183)	26/1645
			ICT/TOR	3739 9765
46	*TORN	NR GODDARD KS (8 W ICT)	(WT# 183)	26/1645
			ICT/TOR	3766 9758
134	*TORN	NR DEER CREEK OK (23 WNW PNC)	(WT# 184)	26/1649
		TORNADO CROSSED HWY 11 NEAR DEERCREEK AND NARDIN.	OKC/LSR	3680 9751
33	*TORN	5 W (ICT) WICHITA ARPT KS	(WT# 183)	26/1651
			ICT/SAO	3764 9753
39	*TORN	7 NE ENID OK (12 NE END)	(WT# 184)	26/1700
			OKC/SVS	3648 9776
41	*TORN	5 E PECK KS (14 SE ICT)	(WT# 183)	26/1700
			ICT/SVS	3748 9726

84	*TORN	EAGLE NE (18 E LNK) TORNADOES RPTD AT EAGLE, ELMWOOD AND PALMYRA.	(WT# 182) OMA/TOR	26/1700 4081 9641
34	*TORN	NR CLEARWATER KS (11 SSW ICT)	(WT# 183) ICT/TOR	26/1705 3750 9750
35	*TORN	NR HAYSVILLE KS (6 SSE ICT)	(WT# 183) ICT/TOR	26/1705 3756 9736
36	*TORN	2 S BEATRICE NE (4 S BIE)	(WT# 182) LNK/SVR	26/1705 4023 9673
37	*TORN	8 W (IAB) MCCONNELL AFB WICHITAKS	(WT# 183) IAB/SAO	26/1710 3761 9743
67	*TORN	5 N (WDG) WOODRING MUNI ARPT ENOK PILOT RPTS MULTIPLE FUNNELS.	(WT# 184) WDG/PIR	26/1700 3646 9778
42	*TORN	PLAINVIEW NE (31 NW OFK)	(WT# 182) OFK/TOR	26/1715 4235 9778
68	*TORN	NR ARKANSAS CITY KS (23 N PNC)	(WT# 183) ICT/TOR	26/1720 3706 9705
65	*TORN	6 SW BILLINGS OK (23 ENE FND)	(WT# 194) OKC/SVS	26/1730
49	*TORN	(IAB) MCCONNELL AFB WICHITAKS ZTNSV DMG TO BASE HOSPITAL.	(WT# 183) IAB/SAO	26/1733 3761 9726
199	*TORN	5 E PALMYRA NE (28) ESE LNK) BARNS/GARAGES DSTRYD..TIME ESTD	(WT# 188) $LNK/LSR	26/1735 4069 9626
70	*TORN	9 NNE PERRY OK (21 SSE PNC) TOR RPTED 2 S OF HWY 15 AND 2 E HWY 77.	(WT# 184) OKC/LSR	26/1752 3643 9721
140	*TORN	NR MARLAND OK (11 SSW PNC) LRG TORNADO NR MARLAND	(WT# 184) OKC/LSR	26/1800 3656 9715
167	*TORN	ANDOVER KS (16 ENE ICT) 22 DEAD NMRS INJURIES AND XTNSV DMG.	(WT# 183) ICT/TELCO	26/1800 3771 9713
62	*TORN	NR CAMBRIDGE KS (46 NNE PNC) VERY LRG TORNADO RPTD.	(WT# 183) ICT/TOR	26/1805 3731 9666
63	*TORN	1 NE MT SELMAN TX (19 SEE TYR) 1 INJ HOMES DMGD.	(WT# 192) FTW/SVS	26/1811 3208 9526
69	*TORN	EL DORADO RES KS (36 ENE ICT) TWO TORNADOES RPTD.	(WT# 183) ICT/TOR	26/1815 3786 9681
168	*TORN	HOWARD KS (45 WSW CNU) XTNSV DMG. PRBL DEATHS AND INJURIES. TIME ESTD.	(WT# 187) $ICT/SPS	26/1815 3746 9626
81	*TORN	10 E STILLWATER OK (44 SSE PNC)	(WT# 184) OKC/SVS	26/1830 3611 9686
173	*TORN	5 E BURBANK OK (26 E PNC)	(WT# 193) TUL/LSR	26/1834 3669 9661
82	*TORN	SW MONTGOMERY CO TX (48 NNW HOU) SIGN AN TREE DMG RPTD. PSBL TOR.	(-----) HOU/SVR	26/1839 3033 9546
89	*TORN	NR PANAMA IA (36 NE OMA) TORNADO RPTD NR PANAMA AND WESTPHALIA.	(WT# 188) DSM/LSR	26/1844 4173 9548
83	*TORN	NR MANILLA IA (52 NE OMA)	(WT# 188) DSM/TOR	26/1845 4188 9525
66	*TORN	NR DENISON IA (57 NNE OMA) SVRL TORNADOES RPTD.	(WT# 188) DSM/SVS	26/1850 4201 9535
71	*TORN	1 N YALE OK (45 W TUL)	(WT# 193) TUL/SVS	26/1855 3613 9670

169	*TORN	SRN PAPILLION NE (12 SW OMA) PSBL TORNADO	(WT# 195) OMA/SVS	26/1905 4116 9605
93	*TORN	NR LAKE VIEW IA (46 WSW FOD)	(WT# 195) DSM/TOR	26/1915 4231 9505
87	*TORN	1 W WALL LAKE IA (50 WSW FOD)	(WT# 195) DSM/LSR	26/1917 4228 9511
99	*TORN	SEVERY KS (41 W CNU)	(WT# 194) ICT/SVS	26/1925 3763 9623
95	*TORN	4 SE CLEVELAND OK (29 W TUL)	(WT# 193) TUL/TOR	26/1930 3626 9640
100	*TORN	S WICHITA KS (6 ENE ICT)	(WT# 194) ICT/SVS	26/1930 3769 9733
102	*TORN	7 N KEYSTONE LAKE NORTHEAST OK (27 WNW TUL) TORNADO RPTD 7 N KEYSTONE DAM.	(WT# 193) TUL/SVS	26/1947 3635 9633
107	*TORN	4 W TORONTO LAKE KS (30 WNW CNU)	(WT# 194) ICT/TOR	26/2000 3776 9603
108	*TORN	6 NE TOPEKA KS (3 NNE TOP) PWR LNS EXPLODINGNR K-4 AND US 24.	(WT# 194) TOP/TOR	26/2000 3911 9560
106	*TORN	NR MERIDEN KS (8 NNE TOP)	(WT# 194) TOP/SVS	26/2005 3918 9556
109	*TORN	NR SPERRY OK (9 NW TUL)	(WT# 193) TUL/TOR	26/2014 3630 9600
110	*TORN	NR COPAN OK (10 NNE BVO) PSBL FATALITY. HOUSES DSTRYD.	(WT# 193) ICT/TOR	26/2015 3690 9593
148	*TORN	NR SKIATOOK OK (13 NNW TUL)	(WT# 193) TUL/LSR	26/2017 3636 9600
111	*TORN	3 N VALLEY FALLS KS (23 NNE TOP)	(WT# 194) TOP/TOR	26/2020 3938 9546
114	*TORN	NR NORTONVILLE KS (22 W FLV)	(WT# 194) TOP/SVS	26/2022 3941 9533
?				
182	*TORN			
			TUL/LSR	3636 9600
117	*TORN	NR ATCHISON KS (17 NW FLV) TOR RPTD NR HWY 59.	(WT# 194) TOP/SVS	26/2040 3956 9513
193	*TORN	NR OOLOGAH OK (19 NNE TUL)	(WT# 193) TUL/LSR	26/2048 3644 9570
121	*TORN	NR BAGWELL TX (16 E PRX)	(WT# 197) FTW/SVS	26/2119 3366 9516
122	*TORN	NR NEGLEY TX (22 ENE PRX)	(WT# 197) FTW/SVS	26/2130 3375 9508
203	*TORN	GARNER IA (14 WSW MCW) 5 MOBILS HOMES HEAVILY DMGD	(WT# 198) ALO/LSR	26/2140 4310 9361
124	*TORN	NR ALLERTON IS (29 E 3OI)	(WS# 199) DSM/TOR	26/2215 4069 9336
201	*TORN	HELENA MO (16 NE STJ) HOMES AND BLDGS DMGD	(WT# 194) MCI/LSR	26/2215 3991 9466
152	*TORN	CORYDON IA (33 ENE 3OI)	(WS# 199) DSM/SVS	26/2233 4076 9331
155	*TORN	1 N NEOSHO MO (19 SSE JLN)	(WS# 196) SGF/SVS	26/2245 3688 9436

158	*TORN	NR WISTER OK (20 NNW PGO)	(WS# 200)	26/2255
			FSM/SVS	3496 9471
202	*TORN	COSBY MO (14 ENE STJ)	(WT# 194)	26/2257
		5 INJ HOMES/BLDGS DMGD	MCI/LSR	3986 9468
135	*TORN	NR FAIRMONT OK (12 E END)	(-----)	26/2258
		TORNADO BTWN FAIRMONT AND BRECKENRIDGE.	OKC/LSR	3635 9770
1	A175	10 SW NEWKIRK OK (6 WNW PNC)	(WS# 180)	26/0610
			OKC/LSR	3676 9720
2	G 56	TONKAWA OK (11 WSW PNC)	(WS 180)	26/0630
		TREES DMGD..PWR LNS DWN.	OKC/LSR	3668 9730
3	A 75	KILDARE OK (6 NNE PNC)	(WS# 180)	26/0700
			OKC/LSR	3681 9075
4	G 56	GRAINOLA OK (29 ENE PNC)	(WS# 180)	26/0700
			OKC/LSR	3694 9665
5	A 75	FORAKER OK (30 WNW BVO)	(WS# 180)	26/0750
			OKC/LSR	
6	A175	4 E INDEPENDENCE KS (31 SSW CNU)	(WS# 181)	26/0915
			ICT/SVR	3723 9563
161	A175	3 S MINNEAPOLIS KS (19 N SLN)	(WT# 183)	26/1235
			CNK/LSR	3908 9771
7	A175	3 E DELPHOS KS (18 S CNK)	(WT# 183)	26/1300
			CNK/SVS	3928 9770
50	A75	SPEARSVILLE LA (23 SSE ELD)	(WS# 185)	26/1300
		GOLFBALL CVRG GND.	SHV/LSR	3293 9260
51	WNDG	LOCKHART LA (19 SE ELD)	(WS# 185)	26/1305
		NMRS TREES DWN.	SHV/LSR	3301 9258
8	A 75	9 E GLASCO KS (12 S CNK)	(WT# 183)	26/1320
		RPTD @ JCT HWY 24 & HWY 81.	CNK/SVS	3936 9765
9	A175	2 SE EL DORADO AR (11 ESE ELD)	(WS# 185)	26/1322
			LIT/LSR	3318 9263
10	A275	5 S KINGMAN KS (31 NE P28)	(WT# 183)	26/1330
			ICT/TOR	3756 9811
16	A100	1 S SHARON KS (9 ESE P28)	(WT# 183)	26/1330
			DDC/SPS	3723 9843
52	A175	ROCKY BRANCH LA (14 NW MLU)	(WS# 185)	26/1345
			SHV/LSR	3268 9220
11	A175	CLYDE KS (13 ENE CNK)	(WT# 183)	26/1355
		GOLFBALL SIZE HAIL CVRD THE GRND.	CNK/SVS	3960 9740
162	A175	CLIFTON KS (20 E CNK)	(WT# 183)	26/1359
			CNK/LSR	3956 9726
53	A100	5 NW BASTROP LA (23 N MLU)	(WS# 185)	26/1410
			SHV/LSR	3285 9196
163	A175	BRANTFORD KS (18 NE CNK)	(WT# 183)	26/1414
			CNK/LSR	3971 9736
13	A200	2 W EXETER NE (40 WSW LNK)	(WT# 182)	26/1420
		TIME ESTD.	$GRI/SVS	4064 9750
54	A100	DEAN LA (27 NNW MLU)	(WS# 185)	26/1420
			SHV/LSR	3290 9215
14	A175	SEDGWICK KS (18 N ICT)	(WT# 183)	26/1425
			ICT/SVR	3791 9743
28	A175	THORNTON AR (41 SW PBF)	(-----)	26/1425

15	A175	KINGMAN KS (31 SSW HUT)	LIT/LSR 3378 9248 (WT# 183) 26/1430 ICT/SVR 3764 9811 (WT# 183) 26/1430 CNK/LSR 3978 9710 (WT# 183) 26/1440 ICT/SVS 3771 9803 (WS# 186) 26/1450 LIT/LSR 3416 9265 (WS# 186) 26/1500 $LIT/SVR 3416 9258 (WT# 183) 26/1501 CNK/LSR 3996 9741 (WS# 186) 26/1508 LIT/LSR 3430 9240 (WS# 186) 26/1508 LIT/LSR 3406 9255 (-----) 26/1515 FSD/SVS 4380 9933 (WT# 183) 26/1520 ICT/SVR 3835 9720 (-----) 26/1525 FSD/LSR 4375 9895 (WT# 184) 26/1525 OKC/LSR 3593 9871 (WT# 184) 26/1530 OKC/LSR (WS# 186) 26/1535 LIT/LSR 3463 9233 (WS# 186) 26/1543 LIT/LSR 3473 9228 (WT# 182) 26/1545 OFK/SVS 4253 9896 (WT# 183) 26/1545 ICT/SVS 3839 9713 (WT# 184) 26/1545 OKC/LSR 3653 9815 (WT# 183) 26/1545 CNK/LSR 3819 9751 (WT# 183) 26/1600 TOP/SVS 3903 9611 (WT# 189) 26/1600 HON/SVR 4445 9893 (WS# 186) 26/1605 LIT/LSR 3473 9235 (WT# 184) 26/1607 OKC/LSR 3656 9835 (WT# 184) 26/1610 OKC/LSR 3656 9806 (WT# 182) 26/1610
164	A175	3 SW WASHINGTON KS (33 ENE CNK)	
19	A200	VARNER KS (25 SSW HUT)	
104	A175	5 NW BUNN AR (33 SE HOT)	
17	A175	LEOLA AR (36 SE HOT)	
165	A175	NARKA KS (31 NNE CNK)	
29	A100	SHERIDAN AR (28 WNW PBF)	
105	WNDG	CARTHAGE AR (38 WSW PBF) TREES DWN.	
22	A275	CHAMBERLAIN SD (2 NNW 9V9)	
21	A175	HILLSBORO KS (39 SE SLN)	
27	A175	KIMBALL SD (18 E 9V9)	
127	A100	NR OAKWOOD OK (49 NNE CSM)	
128	A 75	CANTON OK (41 WSW END)	
30	A100	SALINE CO AR (18 WSW LIT) ONE INCH HAIL RPTD AT SHANNON HILLS	
31	A175	SW LITTLE ROCK AR (3 W LIT) NICKLE TO GOLFBALL HAIL AT LITTLE ROCK AND MABLEVALE.	
32	A100	ATKINSON NE (51 E ANW)	
72	A100	1 N MARION RES KS (39 SE SLN)	
129	A 75	GOLTRY OK (17 NW END)	
166	A 75	MOUNDRIDGE KS (21 ENE HUT)	
59	A175	3 SE PAXICO KS (26 W TOP)	
75	A 75	11 W WESSINGTON SD (34 W HON)	
180	A 75	PULASKI CO AR (6 W LIT)	
130	A100	CHEROKEE OK (36 NW END)	
131	A 88	4 W HILLSDALE OK (17 NNW END)	
194	A150	FAIRBURY NE (24 WSW BIE)	

76	A175	BUTTE NE (61 ENE ANW)	LNK/LSR	4014 9716
			(WT# 182)	26/1615
86	WNDG	LAKE CONWAY AR (19 NNW LIT)	OFK/SVS	4291 9885
		TWO TREES DWN.	(WS# 186)	26/1617
182	A 75	OTTO AR (20 N LIT)	LIT/LSR	3498 9238
			(WS# 186)	26/1618
195	A175	PANAMA NE (21 SE LNK)	LIT/LSR	3503 9220
			(WT# 182)	26/1618
190	A175	2 S LOOMIS NE (33 SW EAR)	LNK/LSR	4060 9651
			(WT# 182)	26/1620
85	A175	CONWAY AR (27 NNW LIT)	GRI/LSR	4044 9951
			(WS# 186)	26/1622
132	A 75	NR JEFFERSON OK (26 NNE END)	LIT/LSR	3508 9245
			(WT# 184)	26/1625
47	A173	MARION KS (45 W EMP)	OKC/LSR	3671 9778
			(WT# 183)	26/1635
133	A 88	SOUTHARD OK (42 WSW END)	ICT/SVR	3835 9701
			(WT# 184)	26/1635
185	WNDG	FAULKNER CO AR (31 NNW LIT)	OKC/LSR	3605 9858
		TREES DOWN	(WS# 186)	26/1635
197	A175	ROCA NE (15 SSE LNK)	LIT/LSR	3516 9236
			(WT# 182)	26/1640
119	A 88	FAIRFAX SD (55 SEE 9V9)	LNK/LSR	4064 9665
		DIME AND NICKLE HAIL RPTD.	(WT# 189)	26/1645
177	A175	LA BELLE TX (9 WSW BPT)	FSD/LSR	4303 9890
		GOLFBALL SIZE HAIL	(----)	26/1645
44	A150	HALLAM NE (15 N BIE)	BPT/LSR	2988 9416
			(WT# 182)	26/1649
43	A175	NR GOESSEL KS (30 ENE HUT)	LNK/SVS	4051 9678
			(WT# 183)	26/1650
40	A175	(END) VANCE AFB ENID OK	ICT/SVR	3825 9735
			(WT# 184)	26/1655
198	A175	BEATRICE NE (2 SSE BIE)	END/SAO	3633 9790
			(WT# 182)	26/1659
60	A100	LA BELLE TX (9 WSW BPT)	LNK/LSR	4026 9673
		3/4 TO 1 INCH HAIL.	(-----)	26/1700
120	A 75	GEDDES SD (47 SE 9V9)	BPT/LSR	2988 9416
			(WT# 189)	26/1700
137	A175	BRAMAN OK (19 NW PNC)	FSD/LSR	4325 9870
			(WT# 184)	26/1700
183	A175	HEBER SPGS AR (54 NNE LIT)	OKC/LSR	3603 9733
			(WS# 190)	26/1700
38	A 75	REDFIELD SD (36 NNW HON)	LIT/LSR	3550 9203
			(WT# 189)	26/1703
184	A175	VAN BUREN CO AR (58 SE HRO)	ABR/SVS	4486 9851
		GOLFBALL HAIL AT FAIRFIELD BAY	(WS# 190)	26/1705
191	A175	BEATRICE NE (2 SSE BIE)	LIT/LSR	3558 9255
			(WT# 182)	26/1705
79	A175	FRANKSTON TX (21 SSW TYR)	GRI/LSR	4026 9673
			(-----)	26/1710
			FTW/SVR	3205 9550

178	A150	WRN PORT ARTHUR TX (6 ESE BPT)	(-----)	26/1710
			BPT/LSR	2990 9393
77	A175	OMAHA NE (5 WSW OMA)	(WT# 188)	26/1715
		NMRS RPTS OF 1 INCH TO GOLFBALL HAIL IN OMAHA AREA.	OMA/SVS	4126 9600
136	A 75	GARBER OK (19 ENE END)	(WT# 184)	26/1715
			OKC/LSR	3643 9758
186	WNDG	VAN BUREN CO AR (58 SE HRO)	(WS# 190)	26/1715
		TREE DOWN	LIT/LSR	3558 9255
187	A175	CHICOT CO AR (22 SW GLH)	(WS# 190)	26/1715
			LIT/LSR	3328 9128
78	A175	MOUNTAIN VIEW AR (62 SSW UNO)	(WS# 190)	26/1730
			LIT/SVS	3586 9211
138	A175	BILLINGS OK (22 SW PNC)	(WT# 184)	26/1730
			OKC/LSR	3653 9743
179	A175	VIDOR TX (11 N BPT)	(-----)	26/1730
		GOLFBALL SIZE HALL	BPT/LSR	3011 9401
90	A 75	FERNEY SD (17 ESE ABR)	(WT# 189)	26/1745
		DIME HAIL CVRG GND.	ABR/LSR	4533 9810
48	A 75	(ICT) WICHITA ARPT KS	(WT# 183)	26/1750
			ICT/SAO	3764 9743
64	A175	1 NE MINEOLA TX (23 N TYR)	(WT# 192)	26/1754
			FTW/SVR	3268 9546
91	A175	GROTON SD (15 E ABR)	(WT# 189)	26/1758
			ABR/LSR	4545 9810
139	A 88	5 W PERKINS OK (47 NE OKC)	(WT# 184)	26/1759
			OKC/LSR	3596 9713
73	A175	HARPER KS (30 E P28)	(WT# 183)	26/1800
			ICT/SVS	3728 9801
74	G 56	HARPER KS (30 E P28)	(WT# 183)	26/1800
			ICT/SVR	3728 9801
118	A175	BULLARD TX (15 SSE TYR)	(WT# 192)	26/1800
			SHV/TOR	3213 9533
200	A 75	11 SE (LNK)LINCOLN ARPT NE	(WT# 182)	26/1800
			LNK/LSR	4071 9660
188	A175	CALICO ROCK AR (46 SSW UNO)	(WS# 190)	26/1801
			LIT/LSR	3611 9213
189	A100	BAXTER CO AR (34 SW UNO)	(WS# 190)	26/1805
		ONE INCH HAIL SYCAMORE SPGS	LIT/LSR	3638 9228
141	A125	WHITE EAGLE OK (9 S PNC)	(WT# 184)	26/1807
			OKC/LSR	3660 9708
142	WNDG	E PONCA CITY OK (2 SSE PNC)	(WT# 184)	26/1823
		PWR LNS DWN.	OKC/LSR	3669 9708
80	A100	NORFORK AR (44 SSW UNO)	(WS# 190)	26/1825
			LIT/SVS	3619 9228
171	A275	NR BURBANK OK (21 E PNC)	(WT# 193)	26/1831
		GOLFBALL TO BASEBALL SIZE HAIL	TUL/LSR	3669 9671
172	G 70	NR BURBANK OK (21 E PNC)	(WT# 193)	26/1831
			TUL/LSR	3669 9671
55	A 75	MONTAGUE TX (49 ESE SPS)	(-----)	26/1840
		TIME ESTD.	$SPS/SPS	3366 9771

61	A200	NEW LONDON TX (15 SW GGG)	(WT# 192)	26/1855
		HAIL LRGR THAN GOLFBALL SIZE AT OVERTON AND NEW LONDON.	SHV/TOR	3225 9493
174	A125	JENNINGS OK (38 W TUL)	(WT# 193)	26/1855
			TUL/LSR	3618 9656
94	A175	1 E WILLIS TX (54 NNW HOU)	(-----)	26/1900
			HOU/SVR	3041 9546
175	A275	NR HALLETT OK (38 W TUL)	(WT# 193)	26/1900
		BASEBALL SIZE HAIL	TUL/LSR	3623 9656
96	A275	NR KILGORE TX (9 W GGG)	(WT# 192)	26/1910
			SHV/SVS	3238 9488
170	A 88	NR LITTLE YAZOO MS (32 NNW JAN)	(-----)	26/1910
			JAN/SVR	3271 9036
92	A125	1 N WILLOW SPGS MO (19 NNW UNO)	(WS# 196)	26/1915
			SGF/SVR	3701 9196
88	WNDG	1 NE ODEBOLT IA (55 WSW FOD)	(WT# 195)	26/1920
		WNDW BLWN OUT BY WINDS.	DSM/LSR	4233 9525
98	A175	WELLINGTON KS (26 S ICT)	(WT# 194)	26/1925
			ICT/SVS	3726 9740
101	A175	TOPEKA KS (3 WSW TOP)	(WT# 194)	26/1930
			TOP/SVS	3905 9568
113	A100	NR SHEPHERD TX (52 SSW LFK)	(-----)	26/1930
			HOU/SVS	3050 9501
144	WNDG	PAWNEE CO OK (36 SE PNC)	(WT# 193)	26/1935
		HOMES DMGD IN WESTPORT.	TUL/LSR	3636 9661
97	A275	CHALK HILL TX (4 ESE GGG)	(WT# 197)	26/1937
		ALSO GOLFBALL HAIL AT OAK HILL.	SHV/LSR	3235 9465
145	WNDG	SPERRY OK (9 NW TUL)	(WT# 193)	26/1939
		PWR LNS DWN.	TUL/LSR	3630 9600
103	A100	INDEPENDENCE KS (32 SSW CNU)	(WT# 194)	26/1940
			ICT/SVS	3723 9571
146	WNDG	PAWNEE CO OK (36 SE PNC)	(WT# 193)	26/1951
		XTNSV DMG. CARS OFF RD AT HWY 48 AND CIMMARON TURNPIKE.	TUL/LSR	3636 9661
143	A 75	NEWKIRK OK (10 NNE PNC)	(WT# 193)	26/1952
			OKC/LSR	3688 9705
176	G 52	(TOP)BILLARD ARPT TOPEKA KS	(WT# 194)	26/1952
			TOP/SAO	3906 9561
147	A 75	SKIATOOK OK (13 NNW TUL)	(WT# 193)	26/1957
			TUL/LSR	3636 9600
112	A175	1 SE PARIS TX (3 W PRX)	(WT# 197)	26/2015
		GOLFBALL HAIL AND ICE CHUNKS UP TO 3 INCHES	FTW/LSR	3363 9551
115	A175	PAXICO KS (27 E MHK)	(WT# 194)	26/2025
			TOP/SVS	3906 9616
149	WNDG	1 W SKIATOOK OK (13 NNW TUL)	(WT# 193)	26/2025
		DMG TO PROPANE CO.	TUL/LSR	3636 9601
150	WNDG	COLLINSVILLE OK (11 NNE TUL)	(WT# 193)	26/2035
		PWR LNS DWN.	TUL/LSR	3636 9583
126	A150	1 W WOODVILLE TX (37 SSE LFK)	(WT# 197)	26/2040
			BPT/SVS	3076 9443
116	A150	1 W WOODVILLE TX (37 SSE LFK)	(WT# 197)	26/2045

151	WNDG	OOLOGAH OK (19 NNE TUL) PWR LNS DWN.	BPT/SVR (WT# 193)	3076 9443 26/2045
123	A 88	LIVINGSTON TX (38 SSW LFK) NICKLE HAIL CVRG GND.	TUL/LSR (WT# 197)	3644 9570 26/2050
125	A275	6 WOODVILLE TX (34 SSE LFK) BASEBALL HAIL AT HARMONY.	HOU/LSR (WT# 197)	3069 9493 26/2145
154	G 55	PIPER KS (14 W MKC)	BPT/SVS (WT# 194)	3076 9453 26/2230
153	A475	NR WYANDOTTE OK (27 SSW JLN)	MCI/LSR (WT# 193)	3913 9486 26/2233
157	A100	NE BONHAM TX (28 SSE DUA)	TUL/SVS (-----)	3680 9473 26/2240
156	A175	SENECA MO (21 SSW JLN)	FTW/SVR (-----)	3358 9618 26/2245
159	A 75	FT SCOTT KS (44 ENE CNU)	SGF/SVS (WT# 194)	3685 9460 26/2305
160	A175	HONEY GROVE TX (27 W PRX)	ICT/SVR (-----)	3783 9470 26/2310
			FTW/SVS	3358 9591

TOPLSRICT
TTAA00 KICT 270925

PRELIMINARY LOCAL STORM REPORT
NATIONAL WEATHER SERVICE WICHITA KS
425 AM CDT SAT APR 27 1991

TIME (CDT) EVENT - SEVERE WEATHER APR 26 1991 FOR SOUTH CENTRAL AND SOUTHEAST KANSAS

0652 CDT	70 MPH WIND AT ARKANSAS CITY. LARGE SIGN BLOWN DOWN...TREE AND CHIMNEY DAMAGE.
0900 CDT	1 3/4" HAIL 35 CEDAR VALE
0905 CDT	3/4" HAIL 6N OF SEDAN
1020 CDT	1 3/4" HAIL 4E INDEPENDENCE
1045 CDT	TORNADO NEAR CHERRYVALE. DAMAGED A HOUSE, 180X60 CHICKEN COOP DESTROYED, TOOK OUT SEVERAL FRUIT TREES.
1435 CDT	BASEBALL HAIL 5S KINGMAN
1450 CDT	1 3/4" HAIL 3 W MURDOCK
1509 CDT	1" HAIL AT PRETTY PRAIRIE
1530 CDT	1 3/4" HAIL IN SEDGEWICK
1535 CDT	1 3/4" HAIL IN KINGMAN
1542 CDT	3/4" HAIL 4ENE NEWTON
1535 CDT	3/4" HAIL IN EUREKA
1555 CDT	2" HAIL IN VARNER
1619 CDT	1 3/4" HAIL IN HILLSBORO
1635 CDT	1 3/4" HAIL IN BURRTON
1641 CDT	1" HAIL EAST SIDE OF MARION RESERVOIR
1650 CDT	1 3/4" HAIL AND 65 MPH WIND IN HARPER
1715 CDT	3/4" HAIL IN ANTHONY
1726 CDT	SMALL TORNADO 5N FREEPORT, NO DAMAGE. AT 1728 CDT SAME TORNADO OBSERVED 6S AND 1W OF ARGONIA.
1738 CDT	TORNADO WAS CONWAY SPRINGS
1740 CDT	1 3/4" HAIL IN MARION
1748 CDT	TORNADO IN GODDARD. EXTENSIVE DAMAGE TO A BUSINESS ALONG U.S. HWY 54. NO KNOWN INJURIES AT THIS TIME.
1745 CDT	3/4" HAIL IN GOESSEL
1757 CDT	TORNADO IS CLEARWATER. TORNADO MOVED NORTHEASTWARD AT 1800 CDT WAS IN HAYSVILLE. EXTENSIVE DAMAGE. NO DEATHS, 9 INJURIES, AND 200 HOMES DMGD OR DESTROYED.
1810 CDT	3/4" HAIL AT WSO ICT
1810 CDT	TORNADO IS CLEARWATER. TORNADO MOVED NORTHEASTWARD AND ACROSS SOUTH WICHITA. AT 1829 CDT WAS REPORTED AT MCCONNELL AFB, HIT BASE HOSPITAL AND DAMAGED BASE HOUSING. PROBABLE INJURIES BUT HAVE NOT HEARD OF ANY DEATHS. TORNADO CONTINUE NORTHEASTWARD AND CAUSED EXTENSIVE DAMAGE TO SEVERAL RESIDENTIAL AREAS ON THE EAST SIDE OF WICHITA. AGAIN PROBABLE INJURIES AND DEATHS, BUT NO COUNT AT THIS TIME. AT 1845 CDT TORNADO HIT ANDOVER. DESTROYED AT MOBILE HOME PARK, 8 CONFIRMED DEAD. ALSO HIT A SHOPPING CENTER AND CAUSED EXTENSIVE DAMAGE AND 500

HOMES WERE DAMAGED OR DESTROYED. INJURIES IN ANDOVER ARE IN THE HUNDREDS WITH PROPERTY DAMAGE AT 50 MILLION PLUS DOLLARS. TORNADO CONTINUED NORTHEASTWARD NEAR TOWANDA AND AT 1856 CDT WAS 3W ELDORADO. TORNADO FINALLY LIFTED AROUND CASSODAY AT ABOUT 1930 CDT. AM SURE DEATH TOLL WILL BE HIGHER THAN THE 8 WITH A LARGER NUMBER OF INJURIES.

1728 CDT 1 3/4" HAIL 2S MILTON

1853 CDT TORNADO JUST EAST OF HACKNEY. AT 1905 CDT TORNADO 2 1/2E OF WINFIELD. 1923 CDT TORNADO 12E ATLANTA. IN COWLEY COUNTY REPORTS OF NUMEROUS INJURIES AND 1 DEATH. TORNADO MOVED IN ELK COUNTY ABOUT 1939 CDT. AT 2000 CDT 3 HOMES WERE DESTROYED AND 1 DAMAGED IN RURAL HOWARD. THERE WAS 1 FATALITY AND 2 WITH CRITICAL INJURIES. PROPERTY DAMAGE IN EXCESS OF $200,000.00.

1955 CDT 3/4" HAIL 5N HOWARD

2025 CDT TORNADO NEAR SEVERY. MOVED EWD TO TORONTO LAKE AT 2100 CDT.

2030 CDT TORNADO IN SOUTH WICHITA NEAR 55TH ST SOUTH AND HYDRALIC

2030 CDT 1 3/4" HAIL IN WELLINGTON

2040 CDT 1" HAIL IN INDEPENDENCE

2105 CDT 3/4" HAIL IN DOUGLASS

2110 CDT 3/4" HAIL IN YATES CENTER

2215 CDT TORNADO DAMAGED A BUILDING 5W OF COFFEYVILLE

APRIL 27

0010 CDT 3/4" HAIL IN FORT SCOTT

ELDER

APPENDIX B

FUJITA TORNADO INTENSITY SCALE

Category	Definition--Effective
(F0)	Gale tornado (40-72 mph): Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage sign boards.
(F1)	Moderate tornado (73-112 mph): Moderate damage. The lower limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads.
(F2)	Significant tornado (113-157 mph): Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
(F3)	Severe tornado (158-206 mph): Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
(F4)	Devastating tornado (207-260 mph): Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
(F5)	Incredible tornado (261-318 mph): Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

APPENDIX C

PRELIMINARY REPORT ON AERIAL DAMAGE SURVEY OF THE WICHITA/ANDOVER TORNADO AND COWLEY COUNTY TORNADO OF APRIL 26, 1991

Brian E. Smith
National Severe Storms Forecast Center
Kansas City, Missouri

INTRODUCTION

During the late evening of April 26, 1991, severe thunderstorms spawned violent tornadoes over portions of Kansas and Oklahoma. On April 29, the NOAA Disaster Survey Team investigating the tornado requested an aerial damage survey be conducted. The team felt that the aerial survey would provide the extensive tornado track information despite the fact that the survey would be conducted 5 days after the event. Fujita Intensity Scale classification would be difficult in many areas that had undergone extensive cleanup and use of aerial and ground photographs from other sources taken immediately after the tornado would be necessary.

On April 30, an aerial damage survey was executed over the Wichita/Andover tornado track and the Cowley County tornado track. Jack May, MIC at WSFO Topeka, made an arrangement with the KHP to use one of their pilots and aircraft for the aerial survey. A total of 8 1/2 hours were spent flying over the tornado tracks. A total of 720 photographs were taken at various altitudes over the tornado paths in order to obtain an accurate track of the twisters. The tornado tracks were then accurately plotted on United States Geological Survey 7.5 minute topographic maps.

THE WICHITA/ANDOVER TORNADO

Maximum F-scale: F5
Path Length: 46 miles
Path Width: .4 mile (2,000 feet)

The track of this tornado began 1.5 miles south-southeast of Clearwater, Kansas, where trees were uprooted near the banks of the Ninnescah River. The tornado tracked northeast and had a narrow path width (200 to 300 feet). About 1.5 miles northeast from the touchdown point, the tornado started producing multiple vortices. Numerous suction vortices were observed as the tornado tracked from Clearwater to 3 miles east of Bayneville. The maximum F-scale rating at this time was F3. The

tornado continued tracking northeast and veered northward just northwest of Haysville and then turned toward the right as it crossed the Wichita Valley Center Floodway. The tornado then was beginning to move into more urban area of south Wichita where the maximum F-scale was between F2 and F3. The tornado, still narrow, passed 0.5 miles south of the South Wichita Interchange of the Kansas Turnpike. The tornado went across the south portion of Mona Kay Heights, destroying mobile homes and unroofing frame homes.

The tornado track continued toward McConnell Air Force Base. A roof was damaged on a building on the Boeing Aircraft Company's property, just west of McConnell's main runways. The tornado continued across the runways and passed 1,000 feet south of a flight line of B-1B bombers. Several buildings on the south portion of the air base sustained between F2 to F3 damage, including the Officer's Club and base hospital. On eastern sections of the base, the tornado passed across base housing removing roofs and causing extensive damage to the second floor of two-story apartment houses. The Wineteer School on the base also received F2-type damage.

As the tornado continued moving northeast, the path width widened dramatically to 500-600 feet. Severe damage was experienced in the Greenwich Heights Subdivision where some homes were flattened, leaving behind just the foundation. This is where the tornado reached F4 intensity, producing F3 to F4 damage to homes in the Springdale Subdivision. These homes were large and well built.

The tornado continued on a northeast path reaching a subdivision where the tornado reached F5 intensity. Several homes were blown clean off their foundations and the debris scattered away from the homes. This subdivision was located just west of the Golden Spur Mobile Home Park. The tornado continued moving northeast and obliterated the mobile home park. Most of the deaths associated with the Wichita/Andover tornado occurred in the mobile home park. From the debris pattern in the subdivision and the mobile home park, it was determined that the storm was now a large multiple vortex tornado. The mobile home devastation was some of the worst that this surveyor has ever seen. Most of the mobile homes were destroyed, leaving behind only twisted frames.

After exiting the mobile home park, the tornado tracked into more rural territory still producing F3 to F4 intensity damage. Three miles northeast of the mobile home park, the tornado widened to its maximum width of 0.4 miles (2,000 feet). The tornado then crossed the Kansas Turnpike and headed toward the town of Towanda. Intensity varied between F2 to F3 as the tornado passed within 0.5 miles southeast of Towanda. Spectacular suction vortices were observed in fields 1 mile south of the town.

The tornado entered an oil field 4 miles west of El Dorado. One tank, filled with oil, was rolled and bounced 0.8 miles. The final resting point of this tank was never

determined; it either broke up at its final landing point or was picked up before the survey was conducted. The tornado also destroyed two other oil tanks. The tornado appeared to begin to weaken as it continued northwest of El Dorado. Damage was spotty and mainly F1 in intensity until the track ended approximately 5 miles north of El Dorado.

When originally conducting the survey, scattered debris was indicated further northeast where isolated damage was indicated 14 miles northeast near Cassoday. At first glance, it appeared that the tornado may have skipped to Cassoday. However, thanks to a ground survey and reports from storm chasers, it was determined that this was another twister. It appears that the rotating thunderstorm occluded at this point near El Dorado. A new tornado had developed to the right of the old one, touching down on the north side of El Dorado Lake, and tracked parallel to the Kansas Turnpike to near Cassoday. This tornado, unfortunately, never surveyed from the air, was weaker than its predecessor, reaching barely F2 in strength. This tornado obtained national media attention when a camera crew from a Wichita television station sought shelter beneath an overpass on the Kansas Turnpike as the tornado passed nearly overhead. The path length of this tornado was 14 miles with a width of 600 feet. The starting point was 6 miles northeast of El Dorado and ended 1 mile northeast of Cassoday.

THE COWLEY COUNTY TORNADO
Maximum F-scale: F4
Path Length: 24.4 miles
Path Width: 1,600 feet

The touchdown of this tornado was 5 miles west-northwest of Arkansas City, Kansas. The tornado produced F1 damage mainly to trees and moved 1.5 miles north where it crossed the Arkansas River. Traces of tornado damage was visible in fields at this point in the track. Approximately 2 miles south-southwest of Strother Airport, a large scratch mark was visible in a field. This scratch mark was caused by a large object, apparently a grain bin or silo. The object appears to have been picked up by three separate suction vortices before landing in a field 0.6 miles away. As the tornado continued northeast, numerous suction vortices were visible. The tornado passed right over Pleasant Valley Cemetery, knocking over numerous tombstones before crossing U.S. Highway 77, 1.25 miles south of Strother Airport.

The tornado widened somewhat as it continued producing F3 damage to farm homes. The tornado reached maximum intensity of F4 to several homes approximately 2 miles east of Strother Airport. Just before crossing the Walnut River, the tornado veered to the north. Further investigation indicated wind damage not related to the tornado track 0.5 miles south. Therefore, the change in tornado track direction was probably due to a microburst south of the tornado track. The tornado then continued

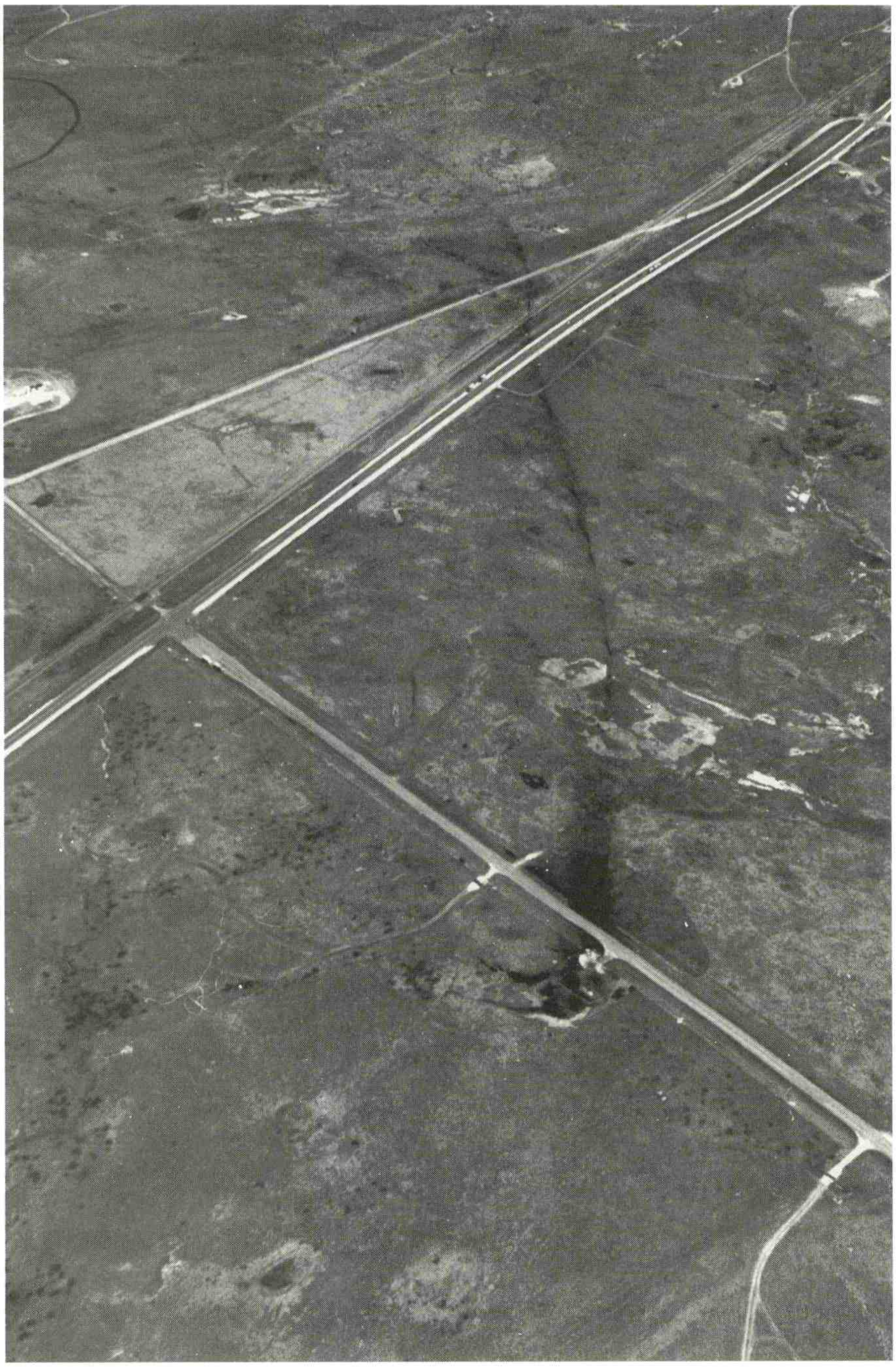
northeast, producing generally F2 damage to trees and barns. The tornado widened to 0.3 to 0.4 miles wide 4 miles east of Winfield. One mile farther northeast, the tornado damaged the Frog Hollow Oil Field. Several oil tanks were rolled coming to rest 0.5 miles from its starting point.

From now until the end of the track, the tornado's intensity was F2 with occasional F3 damage to farm homes. The tornado ended 2.5 miles west-northwest of Burden. Damage to a large grain elevator occurred 0.5 miles southeast of the end of the tornado track. Other wind damage was also observed near the end of the track. It appears a microburst from the rear flank downdraft occurred at the end of the tornado and may have been responsible for the tornado's dissipation.

Another tornado track was discovered 2 miles south of Severy, Kansas, in Elk County. We began mapping this tornado southwestward when the low voltage light came on in the aircraft, indicating an alternator belt had broken. The decision was made to return to Wichita. This tornado, unfortunately, was not surveyed from the air but was probably from the same parent thunderstorm of the Cowley County tornado.

CONCLUDING REMARKS

Scientific aerial surveys need to be conducted for significant tornado events. It is essential to conduct the survey within 24 to 48 hours after the event if at all possible. Also, it is important in a family outbreak, such as the one that occurred on April 26, that a complete survey be conducted. It is also recommended that any comprehensive survey use the expertise of Dr. T. Theodore Fujita and his staff at The University of Chicago. Flying the survey and photographing the tornado tracks is only a small part in analyzing tornado damage. Post-survey work, such as analyzing the track using photogrammetry as done by Dr. Fujita, is a painstaking task that provides invaluable information about the tornado structure. His expertise and photographic laboratory should be included in any future tornado damage survey work conducted by NOAA and the NWS. The NWS needs to establish training programs for aerial surveys and photogrammetry.



Photograph shows a trail of oil from an oil tank that was displaced by the tornado. Photograph courtesy of Brian Smith, NSSFC.

APPENDIX D

CHRONOLOGY OF RELEASES RELATED TO THE WICHITA/ANDOVER TORNADO

Releases by the National Severe Storms Forecast Center

ZCZC MKCSWODY2 000
ACUS2 KMKC 250800
MKC DY2 250800

2ND DAY SEVERE OUTLOOK..REF AFOS NMCGPH980

VALID 261200 - 271200Z .. GEN TSTM FCST NOT INCLUDED..

THERE IS A RISK OF SVR TSTMS TO RT OF LN FM GLS JCT GAG BBW ABR RWF OTM COU CBM ABY AQQ.

DEEP UPR LVL TROF OVR ROCKIES PROGD TO BECOME NEGATIVELY TILTED INTO CNTRL/SRN PLAINS REGION DURG PD AS SHOWN ON AVN PROGS. STG UPR LVL JET MAX PROGD TO ROTATE ARND BOTTOM OF TROF INTO CNTRL AND SRN PLAINS GIVING INCRSG UPR LVL DVRGNC PAT OVR OTLK AREA. DPNG SFC LOW EXPCD TO MOVE NWD FM NEB INTO ND WHILE SCNDRY LOW OVR KS GIVES ZONE OF LOW LVL CNVRGNC AHD OF DRY LN. AMS PROGD TO BECOME QUITE UNSTBL AS SFC DEW PTS INCRS NWD ACRS PLAINS AND MS VLY. SFC BASED LI OF MINUS 6 TO MINUS 10 PROGD OVR OTLK AREA AS LOW LVL SLY JET FM LA INTO IA AIDS DESTBLZTN PROCESS. SVR TSTMS EXPCD ALG GULF CST AREA FM LA INTO AL/NRN FL AS SUBTROP JET MAX MOVES EWD ALG GULF CST GIVING FVRBL VERT SHEAR PAT. OTR SVR TSTMS EXPCD TO DEVELOP DURG AFTN AND EVE OVR CNTRL/SRN PLAINS AHD CDFNT AND DRY LN MOVG EWD IN RESPONSE TO STG JET MAX ROTATING INTO PLAINS. TORNADIC ACTVY LKLY AHD OF CDFNT IN VRY UNSTBL AMS DURG AFTN/EVE AS MID LVL CD ADVCTN INTERACTS WITH WARM AND MOIST AMS AT THE SFC.

..WILSON.. 04/25/91

MKCSWODY2 ALL 00 ACUS2 KMKC 251808
MKC DY2 251800

2ND DAY SEVERE OUTLOOK..REF AFOS NMCGPH980

VALID 261200 - 271200Z ..GEN TSTM FCST NOT INCLUDED..

THERE IS A RISK OF SVR TSTMS RGT OF A LN FM 35 SW PO7 MAF AMA 1K5 BFF 45 W RAP DIK 20 N JMS FAR AXN MCW OTM BYH BHM NBC...CONT...VRB SRQ.

MDLS CONT TO INDC STG TROFFING TKG PLC RESULTING IN DP MID/UPR LVL LO ACRS THE CNTRL RCKYS AND SLOLY PROGRESSING IT EWD INTO WRN NE/WRN KS. AVN LKS VRY IMPRESSIVE AS THE UPR SYS BEGINS TO REDVLP ON THE SRN END OF THE UPR LO...ACRS SRN CO. WITH A SERIES OF VORT MAXS/SHRTWVS ROTG ARND THE UPR SYS...AVN LKS TO HV FVBL SOLN IN HNDLG THIS SYS. CDFNTL BNDRY XPCD TO CONT EWD INTO THE WRN PLNS STS AT START OF PD...THEN MVG SLOLY EWD AS MAIN DRIVE IN THE UPR WNDS WL BE MR NWD/NEWD SOMEWHAT PARALLELING THE FNTL BNDRY. ALL MDLS ARE CONSISTENT IN ROTG MAIN VORT MAX THRU SRN PTNS OF TROF INTO THE CNTRL HI PLANS BTWN 24/36 HRS. MID LVL WND MAX 80/85 KTS FCST ACRS SRN NV THRU SRN NM...THEN NEWD INTO SWRN OK THRU THE PD. LO LVL WNDS ARE FCST TO INCRS RPDLY BY THE BGNG OF THE PD WITH 40/50 KT WNDS XTNDG NWD FM NERN PTNS OF TX INTO THE ERN DAKS BY AFTN. THIS SETS UP VRY STG VERT SHEAR PROFILE FM NRN TX NWD INTO SRN PTNS OF NE FOR SVR TSTM DVLPMNT.

AMS AHD OF SFC DRYLN THAT WL XTND FM WRN KS THRU WRN TX IS XPCD MOIST AND UNSTBL WITH SFC DEWPTS IN THE LO 60S AS FAR N AS SRN NE...AND LO 70S RTNG OF SRN OK. LIFTED INDICES...THUS... ARE FCST TO BE BTWN -6 AND -10 ACRS THE CNTRL AND SRN PLNS.

TSTMS CUD DVLP ALG THE DRYLN ERY IN THE PD AS FIRST VORT MAX ROTS ARND UPR SYS...THEN REDVLP AS STGR SHRTWV/VORT MAX ADVNCS EWD INTO KS/OK. SVR TSTMS XPCD ACRS THE WRN PLNS FM SWRN NE SWD THRU WRN KS INTO PTNS OF WRN TX WHR DIFFLUENT FLO AND PVA ENHNCS UVVS. THE MDLS ARE INDC THIS TO BE A VRY SIG SVR WX PRODUCER WITH TORNADOES OCRG ACRS THE CNTRL/SRN PLNS WITH STG VERT SHEAR AND STG DYNAMICS ENTERING THE RGN DURG THE AFTN AND NGT TIME HRS.

..MCCARTHY..04/25/91

MKCSWODY1 ALL 00 ACUS1 KMKC 260635
MKC AC 260700

CONVECTIVE OUTLOOK..REF AFOS NMCGPH940

VALID 261200 - 271200Z

REF WW NR 179 VALID TIL 09Z.

THERE IS A HIGH RISK OF SVR TSTMS THIS AFTN AND TONIGHT OVR PTNS OF N CNTRL TX..MUCH OF OK..CNTRL AND ERN KS..AND SE NEB. THE HIGH RISK AREA IS TO THE RT OF A LN FM ABI CDS DDC GRI OMA 20 E TOP PRX SEP ABI.

SURROUNDING THE HIGH RISK IS A SLGT RISK OF AVR TSTMS TO THE RT OF A LN FM LIT ELD LFK 30 S AUS ERV 60 S BGS LBL LBF RAP Y26 STC MSP RST ALO LIT.

GEN TSTMS ARE FCST TO THE RT OF A LN FM 60 SW PO7 MAF AMA TAD ASE RWL 50 N GGW...CONT...IWD PAH CHA CAE MYR.

OUTBREAK OF SVR TSTMS AND DMGG TORNADOES IS EXPCD OVR THE NRN PTNS OF THE SRN PLAINS...MUCH OF THE CNTRL PLAINS..AND WRN PTNS OF THE LWR/MID MS VLYS.

DEEPENING UPR LOW PROGD TO MOV SLOLY EWD ACRS WY DURG PD IN CLOSE AGREEMENT WITH AVN PROG...WHICH TENDS TO HOLD UPR LOW FTHR W THAN THE NGM/LFM. THIS SEEMS RSNBL SINCE THERE IS NO SGFNT UPSTRM SYS MOVG INTO WRN U.S. PROGS ALL IN GOOD AGREEMENT IN ROTG SGFNT UPR SHRTWV THRU BASE OF UPR TROF FM AZ/NM BDR INTO THE WRN HI PLAINS/WRN KS BY 00Z. LEADING EDGE OF PVA EXPCD TO RCH THE OK/TX PNHDLS AND WRN KS BY ERY AFTN AND INTERACT WITH DRLN TO PRODUCE WIDESPREAD SVR TSTMS ACRS NRN PTNS OF SRN PLAINS AND MUCH OF THE CNTRL PLAINS.

LOW LVL MOIST AXIS HAS SET UP THIS MRNG FM N CNTRL TX ACRS WRN KS AND INTO CNTRL NEB. INCRG SLY LOW LVL JET ACRS THE CNTRL PLAINS IS EXPCD TO DRAW DEEPER MSTR NWD WITH SFC DWPTS IN THE 60S SPREADING ACRS MOST OF KS AND PSBLY INTO S CNTRL/SE NEB. AMS EXPCD TO BCM EXTRMLY UNSTBL FM N CNTRL TX ACRS CNTRL KS BY AFTN WITH MIN LIS BTN MINUS 8 AND 12. STG MID LVL WIND MAX IN EXCESS OF 70KT IS FCST TO SWEEP NEWD ACRS THE NRN PTN OF THE SRN PLAINS AND KS DURG THE AFTN AND EVE RCHG IA/WRN MO BY THE END OF THE PD. THIS WILL RESULT IN VERY FVRBL DIR SHEAR TO SUPPORT WIDESPREAD SVR TSTM DVLPMT AND DMGG TORNADOES. EXPC INITIAL ACTVTY TO DVLP BY ERY AFTN FM WRN KS SWD INTO THE ERN TX PNHDL AS MID LVL JET MAX/LEADING EDGE PVA MOV ACRS DRYLN AND WRM SECTOR. SQLN SHUD THEN MOV EWD ACRS REST OF KS/OK WITH CELLS MOVG RPDLY NNEWD INTO S CNTRL ND SE NEB UNDER STG UPR LVL WIND FIELD. AS RT REAR QUAD OF MID/UPR LVL WIND MAX DRAGS ACRS OK/NRN TX EXPC SQLN TO DVLP SWD INTO N CNTRL TX.

SVR ACTVTY EXPCD TO BCM MORE ISOLD LTR IN THE EVE AS TSTMS MOV INTO IA/WRN MO/WRN AR AND THERMODYNAMICS WKN. ISOLD SVR TSTMS ALSO PSBL OVR MUCH OF NEB AND SD IN RGN OF INCRG LOW LVL WRM ADVCTN AND STG MID LVL COOLING.

A PUBLIC SVR WX STATEMENT...MKCPWOMKC...WILL BE ISSUED ARN 09Z.

MKCPWOMKC
WOUS36 KMKC 260900
PUBLIC SEVERE WEATHER OUTLOOK
NATIONAL WEATHER SERVICE KANSAS CITY MO
KANSAS CITY MISSOURI
4 00 AM CDT FRIDAY APRIL 26 1991

..OUTBREAK OF TORNADOES AND SEVERE THUNDERSTORMS EXPECTED TODAY INTO TONIGHT OVER MUCH OF THE CENTRAL UNITED STATES..

THE NATIONAL SEVERE STORMS FORECAST CENTER IN KANSAS CITY MISSOURI IS FORECASTING AN OUTBREAK OF SEVERE THUNDERSTORMS AND TORNADOES TODAY INTO TONIGHT OVER MUCH OF THE CENTRAL AND SOUTHERN PLAINS AND THE LOWER MISSOURI VALLEY.

THE STATES WHICH ARE MOST LIKELY TO EXPERIENCE THE BRUNT OF THE SEVERE THUNDERSTORM AND TORNADO ACTIVITY INCLUDE MOST OF OKLAHOMA AND KANSAS...PARTS OF NORTH CENTRAL TEXAS...AND PARTS OF SOUTHERN NEBRASKA.

A LOW PRESSURE AREA OVER NORTHEAST COLORADO IS FORECAST TO DEEPEN RAPIDLY AND MOVE NORTHEAST INTO THE DAKOTAS BY TONIGHT. A STRONG COLD FRONT WIL MOVE EAST ACROSS MUCH OF THE GREAT PLAINS TODAY INTERACTING WITH A WARN AND MOIST AIRMASS.

A STRONG UPPER LEVEL JET STREAM IS FORECAST TO EXTEND FROM NEW MEXICO ACROSS THE TEXAS PANHANDLE INTO KANSAS AND IOWA...WHILE STRONG SOUTHERLY WINDS AT THE SURFACE BRING WARM AND MOIST AIR NORTHARD ACROSS MUCH OF THE CENTRAL UNITED STATES. THIS COMBINATION OF A STRONG JET STREAM MOVING ACROSS A VERY MOIST AND UNSTABLE AIRMASS IS FORECAST TO RESULT IN AN OUTBREAK OF SEVERE THUNDERSTORMS AND DAMAGING TORNDAOES FROM NEBRASKA ACROSS KANSAS AND OKLAHOMA INTO NORTHERN TEXAS.

THERE IS ALSO A LIKLIHOOD OF A FEW SEVERE THUNDERSTORMS THIS AFTERNOON INTO TONIGHT OVER PORTIONS OF NORTHERN NEBRASKA..SOUTH DAKOTA..SOUTHERN MINNESOTA..IOWA..MISSOURI..AND ARKANSAS.

IT IS EMPHASIZED THAT THIS IS A POTENTIALLY DANGEROUS WEATHER SITUATION FOR PARTS OF OKLAHOMA..KANSAS..NORTHERN TEXAS..AND SOUTHERN NEBRASKA. DESTRUCTIVE TORNADOES ARE POSSIBLE WITH THIS WEATHER SYSTEM AS THUNDERSTORMS DEVELOP OVER THE PLAINS DURING THE AFTERNOON AND EVENING HOURS.

ALL PERSONS IN THE THREATENED AREA ARE URGED TO REVIEW SAFETY RULES...AND LISTEN TO RADIO..TV..OR NOAA WEATHER RADIO FOR LATER STATEMENTS AND POSSIBLE WATCHES OR WARNINGS. THIS IS A POTENTIALLY DANGEROUS WEATHER SITUATION FOR THE AFFECTED AREAS AND SHOULD BE MONITORED CLOSELY.

..LARRY WILSON..

NATIONAL SEVERE STORMS FORECAST CENTER

MKCSWODY1 LL OO ACUS1 KMKC 261438
MKC AC 261500

CONVECTIVE OUTLOOK...REF AFOS NMCGPH940

VALID 261500 - 271200Z

REF WW NR 181 VALID TIL 19Z.

THERE IS A HIGH RISK OF SVR TSTMS THIS AFTN AND TONIGHT OVR PTNS OF MUCH OF OK..CNTRL AND ERN KS..CNTRL AND SE NEB...WRN MO...AND NWRN AR. THE HIGH RISK AREA IS TO THE RT OF A LN FM 40 WSW LTS GAG 30 W RSL 50 SW EAR LBF 50 N K20 OFK OMA 20 E SZL 40 E SGF PGO 20 S ADM 40 WSW LTS.

SURROUNDING THE HIGH RISK IS A SLGT RISK OF SVR TSTMS TO THE RT OF A LN FM 20 S BPT 40 S AUS JCT 50 S BGS GAG 30 W RSL 30 W LBF PHP Y26 STC MSP RST OTM 60 E VIH BYH BHM ABY AQQ.

GEN TSTMS ARE FCST TO THE RT OF A LN FM 60 SW P07 MAF 30 W GAG DDC 50 S PUB ASE RWL 20 W SHR 50 N GGW...CONT...IWD MSN PAH CHA CAE MYR.

OUTBREAK OF SVR TSTMS WITH DMGG TORNADOES IS EXPCD OVER THE NRN PTNS OF THE SRN PLAINS AND MUCH OF THE CNTRL PLAINS..WITH OTHER SVR TSTMS EXPCD THROUGH THE RMDR OF THE PLAINS RGN AND ALG THE GULF COAST.

VRY STRONG UPR TROF EXPCD TO BCM MORE NEG TILTED AND MOV INTO PLAINS RGN DURG PD. LO LVL JET MAX OF 45-50 KT PROGGED OVR ERN KS AND ERN NE BY 27/00Z WITH 500 MB JET EXTENDING FM WRN TX NEWD INTO WRN MO. AMS IS EXTRMLY UNSTBL FM CNTRL KS SWD INTO TX AND THIS INSTBY IS EXPCD TO DVLP NEWD INTO NE...WRN MO AND WRN AR BY OOZ. SML AREA OF INTS TSTMS CONTS THIS MORN OVR SERN KS...BUT THIS ACTVTY LKLY TO MOV ON EWD AND NOT CONTAMINATE THE AMS NR LO LVL JET. EXPCT SVR TSTMS TO DVLP BY ERY TO MID AFTN FM CNTRL NE SWD TO WRN OK...ALG CDFNT/DRY LN AS STG PVA MOVS INTO WRM SCTR. THIS ACTVTY LKLY TO DVLP INTO SUPERCELLS WITH TORNADO ACTVTY AS CELLS MOVE NEWD INTO SERN NE...ERN KS...MOST OF OK AND INTO WRN MO AND NWRN AR BY EVE. OTHER SVR TSTMS MAY DVLP NWD ALG OCCLN INTO NRN PLAINS AND SWD ALG DRYLN INTO TX.

A SEPARATE AREA OF SVR TSTMS IS PSBL THIS AFTN AND EVE UNDER SUBTROPICAL JET AND NR WRMFT OVR CNTRL GULF COAST RGN WHERE AMS IS VRY UNSTBL AND SOME LO LVL CONVG IS EXPCD.

A PUBLIC SVR WX STATEMENT...MKCPWOMKC...WILL BE ISSUED ARND 16Z.

..JOHNS.. 04/26/91

MKCPWOMKC
WOUS36 KMKC 261508
PUBLIC SEVERE WEATHER OUTLOOK
NATIONAL WEATHER SERVICE KANSAS CITY MO
KANSAS CITY MISSOURI
1100 AM CDT FRIDAY APRIL 29, 1991

..OUTBREAK OF TORNADOES AND SEVERE THUNDERSTORMS EXPECTED TODAY INTO TONIGHT OVER MUCH OF THE CENTRAL UNITED STATES...

THE NATIONAL SEVERE STORMS FORECAST CENTER IN KANSAS CITY MISSOURI IS FORECASTING AN OUTBREAK OF SEVERE THUNDERSTORMS AND TORNADOES TODAY INTO TONIGHT OVER MUCH OF THE CENTRAL AND SOUTHERN PLAINS AND THE LOWER MISSOURI VALLEY.

THE STATES WHICH ARE MOST LIKELY TO EXPERIENCE THE BRUNT OF THE SEVERE THUNDERSTORM AND TORNADO ACTIVITY INCLUDE MOST OF OKLAHOMA
...CENTRAL AND EASTERN KANSAS...CENTRAL AND SOUTHEASTERN NEBRASKA
...WESTERN MISSOURI...AND NORTHWESTERN ARKANSAS.

A LOW PRESSURE AREA OVER WESTERN NEBRASKA IS FORECAST TO DEEPEN RAPIDLY AND MOVE NORTHEAST INTO THE DAKOTAS BY TONIGHT. A STRONG COLD FRONT WILL MOVE EAST ACROSS MUCH OF THE GREAT PLAINS TODAY INTERACTING WITH A VERY WARM AND MOIST AIRMASS.

A STRONG UPPER LEVEL JET STREAM IS FORECAST TO EXTEND FROM NEW MEXICO ACROSS THE TEXAS PANHANDLE INTO KANSAS AND IOWA...WHILE STRONG SOUTHERLY WINDS AT THE SURFACE BRING WARM AND MOIST AIR NORTHWARD ACROSS MUCH OF THE CENTRAL UNITED STATES. THIS COMBINATION OF A STRONG JET STREAM MOVING ACROSS THE VERY MOIST AND UNSTABLE AIRMASS IS FORECAST TO RESULT IN AN OUTBREAK OF SEVERE THUNDERSTORMS AND DAMAGING TORNADOES FORM NEBRASKA ACROSS KANSAS AND OKLAHOMA...AND EASTWARD INTO WESTERN MISSOURI AND NORTHWESTERN ARKANSAS.

THERE IS ALSO A LIKELIHOOD OF A FEW SEVERE THUNDERSTORMS THIS AFTERNOON INTO TONIGHT OVER PORTIONS OF CENTRAL AND EASTERN SOUTH DAKOTA..

SOUTHERN MINNESOTA..IOWA..EASTERN MISSOURI..SOUTHERN AND EASTERN ARKANSAS..TEXAS...AND PORTIONS OF THE GULF COSTAL REGION.

IT IS EMPHASIZED THAT THIS IS A POTENTIALLY DANGEROUS WEATHER SITUATION FOR PARTS OF OKLAHOMA..KANSAS..NEBRASKA..WESTERN MISSOURI..AND NORTHWEST ARKANSAS. DESTRUCTIVE TORNADOES ARE POSSIBLE WITH THIS WEATHER SYSTEM AS THUNDERSTORMS DEVELOP OVER THE PLAINS DURING THE AFTERNOON AND EVENING HOURS.

ALL PERSONS IN THE THREATENED AREA ARE URGED TO REVIEW SAFETY RULES...AND LISTEN TO RADIO..TV..OR NOAA WEATHER RADIO FOR LATER STATEMENTS AND POSSIBLE WATCHES OR WARNINGS. THIS IS A POTENTIALLY DANGEROUS WEATHER SITUATION FOR THE AFFECTED AREAS AND SHOULD BE MONITORED CLOSELY.
..BOB JONES..
NATIONAL SEVERE STORMS FORECAST CENTER

:370,0990 400,0981 400,0955 370,0963:WWUS9 KMKC 261710
MKC WW 261710
KSZOOO-270100

BULLETIN - IMMEDIATE BROADCAST REQUESTED
TORNADO WATCH NUMBER 183
NATIONAL WEATHER SERVICE KANSAS CITY MO
1210 PM CDT FRI APR 26 1991

.A..THE NATIONAL SEVERE STORMS FORECAST CENTER HAS ISSUED A TORNADO WATCH FOR

PARTS OF CENTRAL AND EASTERN KANSAS

EFFECTIVE THIS FRIDAY AFTERNOON AND EVENING UNTIL 800 PM CDT.

THIS IS A PARTICULARLY DANGEROUS SITUATION WITH THE POSSIBILITY OF VERY DAMAGING TORNADOES. ALSO..LARGE HAIL..DANGEROUS LIGHTING AND DAMAGING THUNDERSTORM WINDS CAN BE EXPECTED.

THE TORNADO WATCH AREA IS ALONG AND 65 STATUTE MILES EAST AND WEST OF A LINE FROM 45 MILES EAST SOUTHEAST OF MEDICINE LODGE KANSAS TO 45 MILES NORTHEAST OF CONCERTI KANSAS.

REMEMBER...A TORNADO WATCH MEANS CONDITIONS ARE FAVORABLE FOR TORNADOES AND SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA. PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS.

B..OTHER WATCH INFORMATION..THIS TORNADO WATCH REPLACES SEVERE THUNDERSTORM WATCH NUMBER 181. WATCH NUMBER 181 WILL NOT BE IN EFFECT AFTER 100 PM CDT.

C...$$ TORNADOES AND A FEW SVR TSTMS WITH HAIL SFC AND ALF TO 3 IN. EXTRM TURBC AND SFC WND GUSTS TO 75 KNOTS. A FEW CBS WITH MAX TOPS TO 600. MEAN WIND VECTOR 23040.

D...LN TCU KVLG FM SW OF CNK TO BTWN RSL AND SLN ATTM. EXPCT RAPID TSTM DVLPMT WITHIN NEXT HR ALG DRYLN/CD FNT WITH SUPERCELLS AND TORNADO DBLPMT LKLY.

E...OTR TSTMS...CONT WW NR 182. WW LKLY TO BE RQRD WITHIN NEXT HR OR TWO OVR PTNS WRN AND CNTRL OK. WW LKLY TO BE RQRK LATER THIS AFTN OVR PTNS ERN KS AND WRN MO.

...JOHNS

Messages Issued by WSO Wichita Pertaining to Wichita/Andover Thunderstorm

TOPTOPICT
TTAAOO KICT 262229
KSCO77-191-262245

BULLETIN - EBS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE WICHITA KS
526 PM CKT FRI APR 26 1991

THE NATIONAL WEATHER SERVICE IN WICHITA HAS ISSUED A TORNADO WARNING EFFECTIVE UNTIL 545 CDT FOR PEOPLE IN THE FOLLOWING LOCATIONS

IN SOUTH CENTRAL KANSAS

NORTHEASTERN HARPER COUNTY...NORTHWESTERN SUMMER COUNTY

AT 515 PM CDT...A TORNADO WAS REPORTED 7 MILES EAST OF ANTHONY MOVING TO THE NORTHEAST AT 35 MPH. THE TOWN OF DANVILLE AND ARGONIA ARC IN THE PATH OF THE STORM.

THIS IS A VERY DANGEROUS STORM. ACT QUICKLY. IF YOU ARE IN THE PATH OF THIS TORNADO MOVE TO A SHELTER BELOW GROUND IF AVAILABLE OTHERWISE... GO TO A SMALL INTERIOR ROOM ON THE LOWEST FLOOR POSSIBLE...AVOID WINDOWS...ABANDON CARS AND MOBILE HOMES FOR A STURDIER BUILDING OR GET INTO A DITCH OR CULVERT.

HEDGES

TOPSVRICT
TTAAOO KICT 262206
KSC173-262330-

BULLETIN - IMMEDIATE BROADCAST REQUESTED
SEVERE THUNDERSTORM WARNING
NATIONAL WEATHER SERVICE WICHITA KS
535 PM CDT FRI APR 26 1991

THE NATIONAL WEATHER SERVICE IN WICHITA HAS ISSUED A SEVERE THUNDERSTORM WARNING EFFECTIVE UNTIL 6:00 PM CDT FOR PEOPLE IN THE FOLLOWING LOCATION

IN SOUTH CENTRAL KANSAS
...SOUTHWESTERN SEGWICK COUNTY

AT 525 PM CDT...RADAR..INDICATED SEVERE THUNDERSTORM NEAR THE TOWN OF MILTON...IN NORTHWEST SUMMER COUNTY MILTON IS 30 MILES SOUTHWEST OF WICHITA. THIS STORM IS MOVING TO THE NORTHEAST AT 35 MPH THE TOWNS OF ANNES...CLONMEL...AND CLEARWATER ARE IN THE PATH OF THIS STORM TAKE COVER IMMEDIATELY.

A TORNADO WATCH IS ALSO IN EFFECT FOR THE WARNED AREA...REMEMBER SEVERE THUNDERSTORMS CAN AND OCCASIONALLY DO PRODUCE TORNADOES WITH LITTLE OR NOW ADVANCE WARNING.

TOPSVSICT
TTAAOO KICT 262244
KSZOO9-011-012-014-017-262345-

SEVERE WEATHER STATEMENT
NATIONAL WEATHER SERVICE WICHITA KS
543 PM CDT FRI APR 26 1991

AT 540 PM CDT...A TORNDO WAS REPORTED JUST SOUTH OF CONWAY SPRINGS MOVING TOWARD CONWAY SPRINGS. IF YOU ARE IN OR NEAR CONWAY SPRINGS TAKE COVER IMMEDIATELY.

TORNADO WATCHES CONTINUE FOR MUCH OF SOUTH CENTRAL AND SOUTHEAST KANSAS.

BURKE

TOPTORICT
TTAAOO KICT 262250
KSC173-191-262315-

BULLETIN - EBS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE WICHITA KS
546 PM CDT FRI APR 26 1991

THE NATIONAL WEATHER SERVICE IN WICHITA HAS ISSUED A TORNADO WARNING EFFECTIVE UNTIL 615 PM CDT FOR PEOPLE IN THE FOLLOWING LOCATIONS.

IN SOUTH CENTRAL KANSAS

...SEDGWICK COUNTY...NORTHWESTERN SUMMER COUNTY

AT 545 PM...TORNADO WERE REPORTED NEAR CONWAY SPRINGS...OR 26 MILES SOUTHWEST OF WICHITA...AND NEAR GOODARD...OR 14 MILES WEST OF WICHITA. THIS INCLUDES THE CITY OF WICHITA.

THIS IS A VERY DANGEROUS STORM...ACT QUICKLY...IF YOU ARE IN THE PATH OF THIS TORNADO MOVE TO A SHELTER BELOW GROUND IF AVAILABLE OTHERWISE...GO TO A SMALL INTERIOR ROOM ON THE LOWEST FLOOR POSSIBLE...AVOID WINDOWS...
ABANDON CARS AND MOBILE HOMES FOR A STURDIER BUILDING OR SET INTO A DITCH OR CULVERT.

HEDGES

TOPSVSICT
TTAAOO KICT 262305
KSZ009-011-012-014-017-260015

SEVERE WEATHER STATEMENT
NATIONAL WEATHER SERVICE WICHITA KS
605 PM CDT FRI APR 26 1991

AT 600 PM CDT...A TORNADO WAS REPORTED BY THE HAYSVILLE POLICE DEPARTMENT AT 77 STREET SOUTH AND WEST STREET. MOVEMENT WAS NORTHEAST AT 30 MILES AN HOUR.

ANOTHER TORNADO WAS REPORTED 5 EAST OF PECK...WHICH IS 14 MILES SOUTH OF WICHITA.

IF YOU ARE IN OR NEAR HAYSVILLE...DERBY OR MULVANE - TAKE COVER NOW
BURKE

TOPTORICT
TTAAOO KICT 26312
KSC173-262345-

BULLETIN - EBS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE WICHITA KS
609 PM CDT FRI APR 26 1991

THE NATIONAL WEATHER SERVICE IN WICHITA HAS ISSUED A TORNADO WARNING EFFECTIVE UNTIL 645 PM CDT FOR PEOPLE IN THE FOLLOWING LOCATION

IN SOUTH CENTRAL KANSAS

EASTERN SEDGWICK COUNTY

AT 605 PM CDT...A TORNADO WAS REPORTED ON THE GROUND IN THE VICINITY OR CLEARWATER...OR 16 MILES SOUTHWEST OF WICHITA. ANOTHER TORNADO WAS REPORTED NEAR HAYSVILLE PERSONS IN HAYSVILLE...DERBY MULVANE...TAKE COVER IMMEDIATELY YOU ARE IN THE PATH OF THIS STORM. THE STORM WAS MOVING TO THE NOREAST AT 35 MPH.

THIS IS A VERY DANGEROUS STORM. ACT QUICKLY. IF YOU ARE IN THE PATH OF THIS TORNADO MOVE TO A SHELTER BELOW GROUND IF AVAILABLE OTHERWISE...GO TO A SMALL INTERIOR ROOM ON THE LOWEST FLOOR POSSIBLE...AVOID WINDOWS...
ABANDON CARS AND MOBILE HOMES FOR A STURDIER BUILDING OR GET INTO A DITCH OR CULVERT.

HEDGES

TOPSVSICT
TTAAOO KICT 262329
KSZ009-011-012-014-017-260100

SEVERE WEATHER STATEMENT
NATIONAL WEATHER SERVICE WICHITA KS
629 PM CDT FRI APR 26 1991

AT 625 PM CDT...TORNADO SPOTTERS HAD THE LOCATION OF ONE TORNADO ON MCCONEL AIR FORCE BASE MOVING NOREST AT 35 MILES AND HOUR.

IF YOU ARE IN OR NEAR THE EAST SIDE OF WICHITA...TAKE COVER NOW!

BURKE

TOPTORICT
TTAAOO KICT 262333
KSC015-270000-

BULLETIN - EBS ACTIVATION REQUESTED
TORNADO WARNING

NATIONAL WEATHER SERVICE IN WICHITA HAS ISSUED A TORNADO WARNING EFFECTIVE UNTIL 730 PM CKT FOR PEOPLE IN THE FOLLOWING LOCATION

IN SOUTH CENTRAL KANSAS

...BUTLER COUNTY...

AT 630 PM CDT...A DAMAGING TORNADO WAS ON THE GROUND IN SOUTHEAST WICHITA...MOVING TO THE NORTHEAST AT 35 MPH THE COMMUNITIES OF AGUST AND ANDOVER ARE IN THE PATH OF THIS STORM.

THIS IS A VERY DANGEROUS STORM...ACT QUICKLY...IF YOU ARE IN THE PATH OF THIS TORNADO MOVE TO A SHELTER BELOW GROUND IF AVAILABLE OTHERWISE...GO TO A SMALL INTERIOR ROOM ON THE LOWEST FLOOR POSSIBLE...AVOID WINDOWS...
ABANDON CARS AND MOBILE HOMES FOR A STURDIER BUILDING OR GET INTO A DITCH OR CULVERT.

HEDGES

TOPSVSICT
TTAAOO KICT 270001
KSZOO9-011-012-014-017-26010-

SEVERE WEATHER STATEMENT
NATIONAL WEATHER SERVICE WICHITA KS
701 PM CDT FRI APR 26 1991

AT 650 PM CDT...SEDGWICK COUNTY TORNADO SPOTTERS WERE STILL FOLLOWING THE TORNADO WHICH WENT THROUGH SOUTH AND EAST PARTS OF WICHITA. IT WAS LOCATED ABOUT 3 MILES WEST OF EL DORADO.

ALSO...IN COWLEY COUNTY TORNADOS WERE MOVING WERE MOVING INTO THE AREA NORTHEAST OF ARKANSAS CITY...WITH TENNIS BALL-SIZE HAIL NEAR WINFIELD.

MOVEMENT WAS NORTHEAST AT 30 MILES AN HOUR.

BE ALERT TO CHANGING WEATHER SITUATIONS AND TAKE COVER IF THREATENING CONDITIONS APPEAR.

BURKE

APPENDIX E

CHRONOLOGICAL SUMMARY OF ACTIONS AND REPORTS AT WSO WICHITA

Numerous thunderstorms, many severe, plagued south-central Kansas throughout the day. At 4:36 p.m. (26/2141 UTC), WSO Wichita issued a severe thunderstorm warning, the first warning on the storm that would later produce the Wichita/Andover tornado. At that time, the storm had not yet become tornadic and was located southwest of Wichita in Harper County. A severe thunderstorm warning was issued for Harper County effective until 5:45 p.m. The warning mentioned that large hail had been reported with the storm when it was in northern Oklahoma. The warning also mentioned that "...severe thunderstorms can and occasionally do produce tornadoes with little or no advance warning." Spotter networks in the Wichita area were activated at 4:45 p.m.

The tornado report spawned by the supercell thunderstorm touched down at 5:15 p.m. in a field 7 miles northeast of Anthony in Harper County. This report from the Harper County Sheriff's Office was relayed to WSO Wichita at 5:26 p.m. Another report from the Harper County Sheriff's Office indicated a funnel cloud touching the ground at 5:26 p.m., 5 miles north of Freeport. This was the second of the four tornadoes. Based on these reports, WSO Wichita issued a tornado warning for northeastern Harper and northwestern Sumner Counties at 5:26 p.m. (26/2229 UTC) in effect until 5:45 p.m.

At 5:28 p.m., the Sumner County Sheriff's Office reported the tornado 6 miles west of Kansas Rt. 49 near Argonia in Sumner County. According to reports from the Sumner County Sheriff, the tornado had moved 8 to 10 miles south of Conway Springs by 5:38 p.m. At 5:40 p.m., the tornado was reported just south of Conway Springs. WSO Wichita issued an SVS at 5:43 p.m. (26/2244 UTC), urging people in and near Conway Springs to take cover. At this time, the storm producing the tornado began to move into the ground clutter pattern of the Wichita radar. Post-storm analysis shows this to be the second of the four tornadoes produced by the supercell thunderstorm.

Sedgwick County 911 relayed a report of a tornado in western Sedgwick County at 5:45 p.m. This was followed by another report from Sedgwick County 911 at 5:46 p.m. of a tornado in that same general area crossing U.S. 54, north of Goddard. This was another tornado which had formed in the Wichita area. It was not associated with the thunderstorm that produced the Wichita/Andover tornado. This storm moved on a track separate from the Wichita/Andover tornado track.

The reports coming from western Sedgwick County and Conway Springs were the basis for a tornado warning issued at 5:46 p.m. (26/2250 UTC) for Sedgwick and northwestern Sumner Counties effective until 6:15 p.m. The Sedgwick County EOC sounded tornado sirens in Wichita at 5:40 p.m.

At 5:57 p.m., a tornado was reported approximately 1 mile south of Clearwater in Sedgwick County, and at 6 p.m., the Haysville Police Department reported a tornado at 77th Street South and West Streets in Haysville. WSO Wichita issued an SVS at 6:05 p.m. (26/2305 UTC), relaying these tornado reports and urging people in the communities in the path of the tornado to take cover. Conflicting reports from spotters added some confusion into the warning process. Employees at the WSO began to wonder if there was more than one tornado south of Wichita since reports were flowing into the office that located the tornado at different places at almost the same time. Nevertheless, a decision was made at this point to extend the tornado warning for eastern Sedgwick County. This warning was issued at 6:09 p.m. (26/2312 UTC) effective until 6:45 p.m. All during this time, the tornado remained in the ground clutter pattern of the Wichita radar.

A storm spotter reported the tornado 2 miles north of Clearwater at 6:10 p.m. At 6:20 p.m., the Sumner County Sheriff relayed a report of the tornado in Haysville in Sedgwick County. At 6:27 p.m., the tornado was reported at 47th Street South and Oaklawn on the south side of Wichita. At about the same time, Air Force weather observers reported a tornado on McConnell Air Force Base. The WSO had high confidence in this report, and an SVS was issued at 6:29 p.m. (26/2329 UTC), urging people on the east side of Wichita to take cover. Also at 6:30 p.m. (26/2333 UTC), a tornado warning was issued for Butler County effective until 7:30 p.m. The warning text specifically identified Andover as being in the path of the tornado and included call to action statements. At 6:40 p.m., an amateur radio spotter reported the tornado east of U.S. 54 going into Andover.

Commercial power was lost at the WSO shortly after 6:45 p.m. Several minutes were needed to bring equipment up on emergency power; however, this did not delay issuing any warnings. The staff had planned to switch to backup power at 5:30 p.m., but by then a tornado was already reported southwest of Wichita. The WSO Wichita Station Duty Manual recommends switching to emergency power whenever thunderstorms are within 25 miles of the station.

Sedgwick County spotters were still following the Andover tornado, and at 6:55 p.m., they reported the twister in Butler County about 3 miles west of El Dorado. At 6:56 p.m., the El Dorado Police Department also reported the tornado 3 miles west of El Dorado. An SVS was issued at 7:01 p.m. (27/0001 UTC). At 7:10 p.m., a report was received of a tornado 2 miles north of El Dorado. The aerial survey conducted by the team showed that this was the fourth tornado produced by the supercell. Another SVS was issued at 7:14 p.m. (27/0015 UTC). The tornado warning was extended for northern Butler County at 7:17 p.m. (27/0021 UTC). The last report concerning this tornado had it moving through Cassoday in northern Butler County at 7:35 p.m. This was a delayed report that was actually received at 10:03 p.m.

Chronology of Events at WSO Wichita
from 3:30 p.m. to 8:30 p.m., CDT

330 PM		REPORTS FROM SEDGWICK IN HARVEY COUNTY OF HAIL 1 3/4 INCH.
335 PM	SVR	SEVERE THUNDERSTORM WARNING FOR NORTHERN CHASE COUNTY OF C KS. AT 335 PM MARBLE SIZE HAIL WAS REPORTED IN CENTRAL CHASE COUNTY MOVG NE AT 35 MPH. EFFECTIVE UNTIL 400 PM CDT.
338 PM		MARBLE HAIL JUST SOUTH OF PRETTY PRAIRIE IN RENO COUNTY KS.
339 PM	SVR	SEVERE THUNDERSTORM WARNING FOR SOUTHEASTERN RENO COUNTY OF SC KS. AT 338 PM CDT MARBLE SIZE HAIL WAS REPORTED JUST SOUTH OF PRETTY PRAIRIE...OR 20 MILES SOUTH OF HUTCHINSON. MOVG NE AT 35 MPH. CASTLETON...HAVEN AND YODER ARE IN THE PATH OF THIS STORM. TAKE COVER IMMEDIATELY. EFFECTIVE UNTIL 430 PM CDT.
340 PM		KAKE TV WICHITA KS SPOTTER REPORTED 1/8 INCH HAIL IN CITY OF KINGMAN IN KINGMAN COUNTY KS.
342 PM		AGTAP SPOTTER REPORTED 3/4 INCH HAIL 4 MILES EAST NORTHEAST OF NEWTON IN HARVEY COUNTY KS.
344 PM		RENO COUNTY EOC REPORTING PEA SIZED HAIL AND HEAVY RAINS.
350 PM	SVR	SEVERE THUNDERSTORM WARNING FOR SOUTHERN MARION COUNTY OF C KS. AT 345 PM CDT RADAR INDICATED A SEVERE THUNDERSTORM OVER NORTHEASTERN HARVEY COUNTY...MOVG NE AT 35 MPH. THE STORM HAS PRODUCED GOLFBALL SIZE HAIL IN HARVEY COUNTY. THE TOWNS OF PEABODY AND AULNE ARE IN THE PATH OF THIS STORM. TAKE COVER IMMEDIATELY. EFFECTIVE UNTIL 430 PM CDT.
355 PM		KAKE TV WICHITA KS SPOTTER REPORTED 2 INCH HAIL IN VARNER IN NORTHERN KINGMAN COUNTY.
413 PM	SVS	AT 405 PM NUMEROUS THUNDERSTORMS OVER MUCH OF CENTRAL AND SOUTHEAST KANSAS. STRONGEST NEAR PEABODY KS AND NEAR ST JOE. MOVG NE AT 35 MPH. AT 340 PM UP TO 2 INCH HAIL WAS REPORTED AT VARNER...WHICH IS 24 MILES SOUTH OF HUTCHINSON. NUMEROUS OTHER REPORTS OF PEA TO GOLFBALL SIZED HAIL HAVE BEEN RECEIVED.
419 PM		MARION COUNTY AT HILLSBORO REPORTED 1 3/4 INCH HAIL.
420 PM		HARVEY COUNTY IN BURRTON REPORTED 1 3/4 INCH HAIL. POSSIBLE WALL CLOUD.
431 PM	SVR	SEVERE THUNDERSTORM WARNING FOR MARION COUNTY OF C KS. AT 425 PM A SEVERE THUNDERSTORM WAS JUST NORTH OF HILLSBORO...OR 41 MILES NORTHEAST OF HUTCHINSON. MOVG NE AT 35 MPH...TOWARD LINCOLNVILLE. THIS STORM PRODUCED GOLFBALL HAIL IN HILLSBORO. (THE TOWNS OF ANTELOPE AND PILSEN ARE IN THE PATH OF THIS STORM--NWR.) EFFECTIVE UNTIL 530 PM CDT.

433 PM	SVR	SEVERE THUNDERSTORM WARNING FOR WESTERN HARVEY COUNTY OF SC KS. AT 420 PM RADAR INDICATED A SEVERE THUNDERSTORM 10 MILES SOUTHEAST OF HUTCHINSON MOVING NE AT 35 MPH...TOWARD PATTERSON AND BURRTON. LARGE HAIL HAS BEEN REPORTED WITH THIS STORM AS IT PASSED EAST OF PRETTY PRAIRIE. EFFECTIVE UNTIL 530 PM CDT.
436 PM	SVR	SEVERE THUNDERSTORM WARNING FOR HARPER COUNTY OF SC KS. AT 437 PM RADAR INDICATED A SEVERE THUNDERSTORM 40 MILES SOUTHWEST OF WICHITA MOVING TO NORTHEAST AT 35 MPH... TOWARD ANTHONY. LARGE HAIL WAS REPORTED WITH THIS STORM IN NORTHERN OKLAHOMA. EFFECTIVE UNTIL 545 PM CDT.
441 PM		MARION COUNTY ON EAST SIDE OF MARION RESERVOIR 1 INCH HAIL REPORTED.
446 PM	SVS	AT 440 PM CDT NUMEROUS THUNDERSTORMS CONTINUED ACROSS MUCH OF CENTRAL AND PARTS OF SOUTHEAST KANSAS. THE STRONGEST STORMS FROM THE WICHITA VICINITY TO NEAR EMPORIA. ANOTHER STRONG STORM 49 MILES SOUTHWEST OF WICHITA...OR JUST NORTH OF WALDRON. MOVG NE AT 35 MPH. AT 445 PM 1 INCH HAIL WAS REPORTED BY COOPERATIVE OBSERVER ON THE NORTHEAST SIDE OF MARION RESERVOIR.
453 PM		KAKE TV IN WICHITA NOTIFIED THAT GOLFBALL HAIL AND 65 MPH WINDS IN HARPER COUNTY.
504 PM	SVR	SEVERE THUNDERSTORM WARNING FOR EASTERN KINGMAN COUNTY AND NORTHWESTERN SUMNER COUNTY OF SC KS. AT 500 PM CDT RADAR INDICATED A SEVERE THUNDERSTORM OVER NORTHEASTERN HARPER COUNTY...MOVG NE AT 35 MPH. AT 450 PM GOLFBALL SIZE HAIL AND 65 MPH WINDS WERE REPORTED AT HARPER...47 MILES SOUTHWEST OF WICHITA. THE COMMUNITIES OF NORWICH AND MILTON ARE IN THE PATH OF THIS STORM. TAKE COVER IMMEDIATELY. EFFECTIVE UNTIL 600 PM CDT.
515 PM		HARPER COUNTY IN ANTHONY REPORTS OF 3/4 INCH HAIL.
515 PM	SVS	AT 512 PM CDT NUMEROUS THUNDERSTORMS WERE ACROSS MUCH OF CENTRAL KANSAS AND PARTS OF SOUTHEAST KANSAS. THE STRONGEST STORMS HAVE PRODUCED UP TO GOLFBALL SIZE HAIL AND WINDS TO 65 MPH...WERE CENTERED 42 MILES SOUTHWEST OF WICHITA NEAR DANVILLE...AND IN NORTHERN OKLAHOMA NORTH OF ENID. MOVG NE AT 35 MPH.
520 PM		2 MILES SOUTH AND 1 MILE EAST OF MILTON IN SUMNER COUNTY...PEA SIZED HAIL AND 40 MPH WINDS.
526 PM		HARPER COUNTY REPORTED FUNNEL TOUCHED GROUND AND WENT BACK UP 5 MILES NORTH OF FREEPORT MOVING NE.
526 PM	TOR	TORNADO WARNING FOR NORTHEASTERN HARPER COUNTY AND NORTHWESTERN SUMNER COUNTY OF SC KS. AT 515 PM CDT, A TORNADO WAS REPORTED 7 MILES EAST OF ANTHONY MOVING NORTHEAST AT 35 MPH. THE TOWNS OF DANVILLE AND ARGONIA ARE IN THE PATH OF THIS STORM. EFFECTIVE UNTIL 545 PM CDT.
528 PM		2 MILES SOUTH OF MILTON IN SUMNER COUNTY GOLFBALL HAIL WITH WINDS GUSTING TO 50 MPH.

528 PM		TORNADO 6 MILES SOUTH AND 1 MILE WEST OF K49 NEAR ARGONIA IN SUMNER COUNTY.
533 PM		PUBLIC REPORTED POSSIBLE FUNNEL NEAR DOUGLASS IN BUTLER COUNTY. UNCONFIRMED.
535 PM	SVR	SEVERE THUNDERSTORM WARNING FOR SOUTHWESTERN SEDGWICK COUNTY OF SC. AT 525 PM CDT RADAR INDICATED A SEVERE THUNDERSTORM NEAR THE TOWN OF MILTON...IN NORTHWEST SUMNER COUNTY. MILTON IS 30 MILES SOUTHWEST OF WICHITA. THIS STORM IS MOVING TO THE NORTHEAST AT 35 MPH. THE TOWNS OF ANNES...CLONMEL AND CLEARWATER ARE IN THE PATH OF THIS STORM. TAKE COVER IMMEDIATELY. EFFECTIVE UNTIL 630 PM CDT.
538 PM		SUMNER COUNTY SHERIFF REPORTED TORNADO 8 TO 10 MILES SOUTH OF CONWAY SPRINGS.
540 PM	SVR	SEVERE THUNDERSTORM WARNING FOR NORTHEASTERN MARION COUNTY OF C KS. EXTENDED PREVIOUS WARNING ISSUED AT 431 PM CDT. AT 535 PM CDT GOLFBALL SIZE HAIL WAS REPORTED IN MARION...OR 46 MILES WEST OF EMPORIA. THIS STORM IS MOVING TO THE NORTHEAST AT 35 MPH. THE TOWN OF ANTELOPE IS IN THE PATH OF THIS STORM. EFFECTIVE UNTIL 615 PM CDT.
543 PM	SVS	AT 540 PM CDT A TORNADO WAS REPORTED JUST SOUTH OF CONWAY SPRING MOVING TOWARD CONWAY SPRINGS. IF YOU ARE IN OR NEAR CONWAY SPRINGS...TAKE COVER IMMEDIATELY.
545 PM		SUMNER COUNTY SHERIFF REPORTED TORNADO JUST SOUTH OF CONWAY SPRINGS MOVING INTO CONWAY SPRINGS.
545 PM		SEDGWICK 911 REPORTED TORNADO 4 TO 5 MILES WEST OF COLWICH ROAD.
546 PM		TORNADO REPORTED CROSSING US54 NORTH OF GODDARD IN SEDGWICK COUNTY. FROM SEDGWICK 911.
546 PM	TOR	TORNADO WARNING FOR SEDGWICK COUNTY AND NORTHWESTERN SUMNER COUNTY OF SC KS. AT 545 PM...TORNADOES WERE REPORTED NEAR CONWAY SPRINGS...OR 26 MILES SOUTHWEST OF WICHITA...AND NEAR GODDARD...14 MILES WEST OF WICHITA. THIS INCLUDES THE CITY OF WICHITA. EFFECTIVE UNTIL 615 PM CDT.
548 PM		REPORTS FROM GOESSEL IN MARION COUNTY OF .72 INCHES OF RAIN AND 3/4 INCH HAIL.
550 PM	SVR	SEVERE THUNDERSTORM WARNING FOR MARION COUNTY OF C KS. AT 550 PM CDT GOLFBALL SIZE HAIL WAS REPORTED NEAR GOESSEL. THIS STORM WAS MOVING NORTHEAST AT 35 MPH. EFFECTIVE UNTIL 630 PM CDT.
557 PM		TORNADO REPORTED 1 MILE SOUTH OF CLEARWATER IN SEDGWICK COUNTY.
605 PM	SVS	AT 600 PM CDT...A TORNADO WAS REPORTED BY THE HAYSVILLE POLICE DEPARTMENT AT 77 STREET SOUTH AND WEST STREET. MOVEMENT WAS NORTHEAST AT 30 MPH. ANOTHER TORNADO WAS REPORTED 5 MILES EAST OF PECK...WHICH IS 14 MILES SOUTH OF WICHITA. IF YOU ARE IN OR NEAR HAYSVILLE...DERBY OR MULVANE...TAKE COVER NOW.

609 PM	TOR	TORNADO WARNING FOR EASTERN SEDGWICK COUNTY OF SC KS. EXTENDED PREVIOUS WARNING ISSUED AT 546 PM CDT. AT 605 PM CDT A TORNADO WAS REPORTED ON THE GROUND IN THE VICINITY OF CLEARWATER...OR 16 MILES SOUTHWEST OF WICHITA. ANOTHER TORNADO WAS REPORTED NEAR HAYSVILLE. PERSONS IN HAYSVILLE...DERBY...MULVANE...TAKE COVER IMMEDIATELY. YOU ARE IN THE PATH OF THIS STORM. THE STORM WAS MOVING TO THE NORTHEAST AT 35 MPH. EFFECTIVE UNTIL 645 PM CDT.
610 PM		3/4 INCH HAIL AT NATIONAL WEATHER SERVICE, WSO WICHITA KS.
610 PM		SPOTTER REPORTED TORNADO 2 MILES NORTH OF CLEARWATER IN SEDGWICK COUNTY KS.
614 PM		COWLEY COUNTY EOC REPORTED 1/2 INCH HAIL IN EXTREME SOUTHWEST CORNER OF COUNTY.
615 PM		OFF DUTY NATIONAL WEATHER SERVICE PERSONNEL OBSERVED 5/8 INCH HAIL AT 13TH AND ZOO IN WICHITA KS.
616 PM	TOR	TORNADO WARNING FOR EASTERN HARVEY COUNTY OF SC KS. AT 610 PM CDT A FUNNEL CLOUD WAS REPORTED JUST EAST OF SEDGWICK IN SOUTHERN HARVEY COUNTY. SEDGWICK IS 17 MILES NORTH OF WICHITA. THE STORM IS MOVING TO THE NORTHEAST AT 35 MPH. MC LAINS IS IN THE PATH OF THIS STORM. EFFECTIVE UNTIL 654 PM CDT.
620 PM		SUMNER COUNTY SHERIFF REPORTED TORNADO IN HAYSVILLE...SEDGWICK COUNTY.
622 PM		COWLEY COUNTY REPORTED WALL CLOUD AND FUNNEL SW NEAR COWLEY/SUMNER COUNTY LINE.
625 PM	TOR	TORNADO WARNING FOR COWLEY COUNTY OF SC KS. AT 620 PM CDT A DEVELOPING TORNADO WAS REPORTED NEAR ARKANSAS CITY. EFFECTIVE UNTIL 715 PM CDT.
627 PM		NATIONAL WEATHER SERVICE EMPLOYEES SON REPORTED TORNADO ON GROUND AT 47TH SOUTH & OAKLAWN...WEST OF K15.
629 PM	SVS	AT 625 PM CDT TORNADO SPOTTERS HAD THE LOCATION OF ONE TORNADO ON MCCONNELL AIR FORCE BASE MOVING NORTHEAST AT 35 MPH. IF YOU ARE IN OR NEAR THE EAST SIDE OF WICHITA...TAKE COVER NOW.
630 PM	TOR	TORNADO WARNING FOR BUTLER COUNTY OF SC KS. AT 630 PM CDT A DAMAGING TORNADO WAS ON THE GROUND IN SOUTHEAST WICHITA...MOVING TO THE NORTHEAST AT 35 MPH. THE COMMUNITIES OF AUGUSTA AN ANDOVER ARE IN THE PATH OF THIS STORM. EFFECTIVE UNTIL 730 PM CDT.
630 PM		MARION COUNTY SHERIFF REPORTED POSSIBLE TORNADO DAMAGE 7 MILES NORTH. UNCONFIRMED.
635 PM		HARVEY COUNTY 911 POSSIBLE FUNNEL CLOUD HEADING TOWARDS PEABODY KS.
635 PM		MCCONNELL AFB REPORTED THAT TORNADO HAD HIT BASE HOUSING AND SCHOOL.

635 PM		MARION COUNTY SHERIFF REPORTED POSSIBLE FUNNEL NEAR PEABODY.
640 PM	TOR	TORNADO WARNING FOR EASTERN MARION COUNTY OF C KS. AT 640 PM CDT A FUNNEL CLOUD WAS OBSERVED JUST EAST OF PEABODY...OR 36 MILES NORTHEAST OF WICHITA. THE STORM WAS MOVING TO THE NORTHEAST AT 35 MPH. AULNE...FLORENCE AND MARION ARE IN THE PATH OF THIS STORM. EFFECTIVE UNTIL 730 PM CDT.
640 PM		HAM SPOTTER REPORTED TORNADO EAST OF US54 GOING INTO ANDOVER IN BUTLER COUNTY.
650 PM		WINFIELD QUICK TRIP REPORTED HAIL LARGER THAN PEA SIZE. COWLEY COUNTY KS.
653 PM		WINFIELD EOC REPORTED TENNISBALL HAIL IN WINFIELD OF COWLEY COUNTY...ALSO TORNADO HAD BEEN ON GROUND FOR MORE THAN 15 MINUTES. EAST OF TOWN. SECOND POSSIBLE TORNADO SOUTH OF ARKANSAS CITY.
656 PM		EL DORADO PD REPORTED TORNADO ON GROUND 3 MI WEST OF EL DORADO IN BUTLER COUNTY.
701 PM	SVR	SEVERE THUNDERSTORM WARNING FOR SOUTHERN CHASE COUNTY OF C KS. AT 700 PM CDT SEVERE THUNDERSTORMS WERE MOVING INTO SOUTHERN CHASE COUNTY. RADAR INDICATES THAT SOME STORMS MAY CONTAIN VERY LARGE HAIL TO THE SIZE OF GOLFBALLS. THE STORMS WERE LOCATED JUST TO THE EAST OF MATFIELD GREEN AND WONSEVU. MOVEMENT WAS NORTHEAST AT 35 MPH. IF YOU LIVE IN THE TOWNS OF WONSEVU AND MATFIELD GREEN YOU SHOULD TAKE COVER NOW. EFFECTIVE UNTIL 800 PM.
701 PM	SVS	AT 655 PM CDT SEDGWICK COUNTY TORNADO SPOTTERS WERE STILL FOLLOWING THE TORNADO WHICH WENT THROUGH THE SOUTH AND EAST PARTS OF WICHITA. IT WAS LOCATED ABOUT 3 MILES WEST OF EL DORADO. ALSO...IN COWLEY COUNTY TORNADOES WERE MOVING INTO THE AREA NORTHEAST OF ARKANSAS CITY...WITH TENNIS BALL SIZED HAIL NEAR WINFIELD. MOVEMENT WAS NORTHEAST AT 30 MPH.
705 PM	TOR	TORNADO WARNING FOR EASTERN COWLEY COUNTY AND WESTERN ELK COUNTY OF SC AND SE KS. THIS EXTENDS THE PREVIOUS TORNADO WARNING ISSUED FOR COWLEY COUNTY AT 625 PM CDT. AT 705 PM CDT A VERY LARGE TORNADO WAS ON THE GROUND NEAR CAMBRIDGE...20 MILES NORTHEAST OF ARKANSAS CITY. WITH THE MOVEMENT OF THIS STORM TO THE NORTHEAST AT 35 MPH...PEOPLE IN WESTERN ELK COUNTY CAN EXPECT LARGE HAIL AND TORNADOES. THE TOWNS OF CAMBRIDGE AND GRENOLA ARE IN THE PATH OF THIS STORM. TAKE COVER IMMEDIATELY. EFFECTIVE UNTIL 745 PM CDT.
706 PM		WINFIELD IN COWLEY COUNTY REPORTED TORNADO ON GROUND 2 1/2 EAST OF WINFIELD.
711 PM		EL DORADO PD REPORTED TORNADO W OF TOWN MOVING NORTH DID NOT GO THROUGH TOWN.
714 PM	SVS	AT 710 PM CDT THE EL DORADO EMERGENCY PREPAREDNESS OFFICE REPORTED A TORNADO WAS STILL ON THE GROUND 2 MILES NORTH OF EL DORADO MOVING NORTH AT 30 MPH. IT HAD PASSED TO THE WEST OF THE

		CITY OF EL DORADO AND NO REPORTS OF DAMAGE HAD BEEN RECEIVED IN EL DORADO.
713 PM	WWA	NSSFC ISSUED TORNADO WATCH NUMBER 194 FOR PORTIONS OF EASTERN AND CENTRAL KANSAS AND PARTS OF WESTERN MISSOURI FROM 730 PM TO 200 AM CDT. THIS WATCH REPLACED TORNADO WATCH NUMBER 183.
717 PM	TOR	TORNADO WARNING FOR NORTHERN BUTLER COUNTY OF SC KS. EXTENDED PREVIOUS TORNADO WARNING ISSUED AT 630 PM CDT. AT 715 PM CDT EL DORADO PD REPORTED TWO TORNADOES ON THE GROUND OVER EL DORADO RESERVOIR. THESE TORNADOES ARE MOVING TO THE NORTHEAST AT 35 MPH. IF YOU LIVE IN THE TOWNS OF CHELSEA AND CASSODAY...TAKE COVER NOW. THIS IS A VERY DANGEROUS STORM. EFFECTIVE UNTIL 800 PM CDT.
717 PM		EL DORADO PD REPORTED 2 TORNADOES ON GROUND ON EL DORADO RESERVOIR.
718 PM		WICHITA 911 REPORTED FUNNEL CLOUDS AT CENTRAL AND GREEN. UNCONFIRMED.
718 PM		COWLEY COUNTY TORNADO ON GROUND 2 MILES SOUTH OF ATLANTA MOVING NE.
720 PM		CHASE COUNTY SPOTTERS IN SOUTHEAST CORNER REPORTED FUNNELS HEADING NORTH...AND FUNNELS WEST OF EMPORIA.
723 PM		COWLEY COUNTY REPORTED TORNADO NEAR ATLANTA. HAZARDOUS PROPANE TANKS HIT. NUMEROUS INJURIES.
726 PM	TOR	TORNADO WARNING FOR CHASE COUNTY AND NORTHERN GREENWOOD COUNTY OF C AND SE KS. AT 726 PM CDT REPORTS OF FUNNEL CLOUDS HAVE BEEN RECEIVED FROM EASTERN PARTS OF CHASE COUNTY. ALSO THE TORNADOES IN NORTHERN BUTLER COUNTY ARE MOVING INTO SOUTHEAST CHASE AND NORTHWEST GREENWOOD COUNTIES. THE STORMS WERE LOCATED 25 MILES SOUTHWEST OF EMPORIA AND 30 MILES NORTHEAST OF EL DORADO. IF YOU LIVE IN THE TOWN OF TETERVILLE...COTTONWOOD FALLS YOU SHOULD TAKE COVER NOW. EFFECTIVE UNTIL 815 PM CDT.
726 PM		ELK COUNTY SHERIFF TORNADO 5 MILES WEST OF GRENOLA MOVING NE.
735 PM		KANSAS TURNPIKE AUTHORITY REPORTED THAT TORNADO WENT THROUGH SE CASSODAY IN NE BUTLER COUNTY NO INJURIES OR DEATHS. TURNPIKE HIT. REPORT RECEIVED AT 1003 PM. 3 TRAILERS AND 2 HOUSES.
736 PM	SVR	SEVERE THUNDERSTORM WARNING FOR SOUTHERN GREENWOOD COUNTY OF SE KS. AT 735 PM CDT A SEVERE THUNDERSTORM WAS LOCATED 35 MILES NORTHEAST OF ARKANSAS CITY...NEAR CAMBRIDGE TO GRENOLA. REPORTS OF LARGE HAIL AND TORNADOES...NEAR GRENOLA HAVE BEEN RECEIVED FROM THIS THUNDERSTORM. THE THUNDERSTORM IS MOVING TO THE NORTHEAST AT 35 MPH...THE TOWNS OF PIEDMONT AND SEVERY ARE IN THE PATH OF THIS STORM. TAKE COVER NOW. EFFECTIVE UNTIL 830 PM CDT.
739 PM		WINFIELD PD REPORTED THAT TORNADO WAS LEAVING COWLEY COUNTY. 1 FATALITY.

741 PM	SVR	SEVERE THUNDERSTORM WARNING FOR NORTHERN ELK COUNTY OF SE KS. AT 741 PM CDT SEVERE THUNDERSTORMS CONTINUE TO MOVE THROUGH WESTERN AND NORTHERN ELK COUNTY. THE THUNDERSTORM WAS LOCATED 20 MILES WEST OF HOWARD...OR 45 MILES SOUTHEAST OF WICHITA. NUMEROUS REPORTS OF LARGE HAIL AND TORNADOES. MOVEMENT WAS TO THE NORTHEAST AT 35 MPH. IF YOU LIVE IN THE TOWN OF HOWARD YOU SHOULD TAKE COVER NOW. EFFECTIVE UNTIL 830 PM CDT.
745 PM		KAKE TV STORM CHASERS FOLLOWED TORNADO IN SOUTHEAST AND EASTERN PARTS OF CHASE COUNTY TOWARDS EMPORIA. NOT CERTAIN WHEN DISSIPATED. FOOTAGE ON TV.
746 PM	SVR	SEVERE THUNDERSTORM WARNING FOR SOUTHEASTERN CHAUTAUQUA COUNTY AND SOUTHERN MONTGOMERY COUNTY OF SE KS. AT 745 PM CDT RADAR INDICATED A SEVERE THUNDERSTORM 35 MILES SOUTHWEST OF COFFEYVILLE...OR JUST SOUTH OF THE TOWN OF CHAUTAUQUA. THE STORM WAS MOVING TO THE NORTHEAST AT 35 MPH. IF YOU LIVE IN THE TOWNS OF CHAUTAUQUA...CANEY AND TYRO...YOU SHOULD PREPARE FOR LARGE HAIL AND WINDS GREATER THAN 60 MPH. EFFECTIVE UNTIL 830 PM CDT.
752 PM		HEARD OVER NAWAS THAT MCCONNELL AIR FORCE BASE'S HOSPITAL LEVELED.
755 PM		ELK COUNTY SHERIFF HAIL UP TO 3/4 INCH FUNNEL DIPPING DOWN TO W/SW.
758 PM		GREENWOOD COUNTY SHERIFF REPORTED FUNNEL SOUTHWEST OF SEVERY MOVING TOWARD PIEDMONT.
759 PM	TOR	TORNADO WARNING FOR NORTHERN ELK COUNTY AND SOUTHERN GREENWOOD COUNTY OF SE KS. AT 758 PM CDT THE GREENWOOD COUNTY SHERIFF REPORTED A FUNNEL CLOUD JUST SOUTHWEST OF SEVERY...45 MILES WEST OF CHANUTE. ALSO REPORTS OF FUNNELS HAVE BEEN RECEIVED IN NORTHERN ELK COUNTY. THE STORM WAS MOVING TO THE NORTHEAST AT 35 MPH. THE TOWNS OF SEVERY...PIEDMONT AND CLIMAX ARE IN THE PATH OF THIS STORM. TAKE COVER NOW. EFFECTIVE UNTIL 830 PM CDT.
803 PM		MCCONNELL AFB...MAJOR REPORTED RADAR HOOK ECHO AT 230 DEGREES BY 17 NM.
804 PM	SVR	SEVERE THUNDERSTORM WARNING FOR EASTERN SEDGWICK COUNTY OF SC KS. AT 805 PM CDT RADAR INDICATED A SEVERE THUNDERSTORM NEAR PECK. LARGE HAIL AND WINDS GREATER THAN 60 MPH ARE POSSIBLE WITH THIS STORM. MOVEMENT WAS NORTHEAST AT 40 MPH. IF YOU LIVE IN THE TOWNS OF HAYSVILLE AND DERBY...YOU SHOULD TAKE COVER NOW. EFFECTIVE UNTIL 845 PM CDT.
813 PM	SVR	SEVERE THUNDERSTORM WARNING FOR MONTGOMERY COUNTY OF SE KS. AT 814 PM CDT RADAR INDICATED SEVERE THUNDERSTORMS IN SOUTHERN MONTGOMERY COUNTY..CENTERED 20 MILES WEST OF COFFEYVILLE...NEAR CANEY. THIS WARNING NOW INCLUDES ALL OF MONTGOMERY COUNTY. THE STORMS WERE MOVING TO THE NORTHEAST AT 35 MPH AND WILL MOVE INTO WAYSIDE AND INDEPENDENCE WITHIN THE NEXT 30 MINUTES. TAKE COVER NOW. EFFECTIVE UNTIL 900 PM CDT.

814 PM		WEATHER DATA SPOTTERS REPORT WALL CLOUD AND FUNNEL CLOUD 3 NW OF WELLINGTON IN SUMNER COUNTY KS.
816 PM	SVR	SEVERE THUNDERSTORM WARNING FOR NORTHERN SUMNER COUNTY OF SC KS. AT 815 PM CDT RADAR INDICATED A SEVERE THUNDERSTORM 30 MILES SOUTH OF WICHITA...NEAR BELLE PLAINE. LARGE HAIL AND WINDS GREATER THAN 60 MPH ARE EXPECTED WITH THIS STORM. THE STORMS WERE MOVING TO THE NORTHEAST AT 35 MPH. IF YOU LIVE IN THE TOWN OF MULVANE... TAKE COVER NOW. EFFECTIVE UNTIL 900 PM CDT.
818 PM	SVR	SEVERE THUNDERSTORM WARNING FOR NORTHWESTERN WILSON COUNTY AND WOODSON COUNTY OF SE KS. AT 819 PM CDT SEVERE THUNDERSTORMS PRODUCE LARGE HAIL WERE 35 MILES WEST OF CHANUTE...NEAR SEVERY. LARGE HAIL AND WINDS GREATER THAN 70 MPH ARE POSSIBLE. ALSO...THIS STORM HAS PRODUCED TORNADOES IN GREENWOOD AND ELK COUNTIES. THIS IS A DANGEROUS STORM. THEY ARE MOVING TO THE NORTHEAST AT 35 MPH AND WILL AFFECT THE TOWNS OF COYVILLE...TORONTO AND BATESVILLE. TAKE COVER NOW. EFFECTIVE UNTIL 915 PM CDT.
823 PM	TOR	TORNADO WARNING FOR SOUTHEASTERN GREENWOOD COUNTY FOR SE KS. EXTENDED PREVIOUS TORNADO WARNING ISSUED AT 759 PM CDT. AT 820 PM CDT A TORNADO WAS ON THE GROUND IN SEVERY...45 MILES WEST OF CHANUTE...MOVING TO THE NORTHEAST AT 35 MPH. THIS IS A DANGEROUS SITUATION...TAKE COVER NOW. THE TOWNS OF SEVERY...CLIMAX AND FALL RIVER ARE IN THE PATH OF THIS STORM. EFFECTIVE UNTIL 900 PM CDT.
825 PM		GREENWOOD COUNTY SHERIFF REPORTED TORNADO ON THE GROUND IN SEVERY KS.
825 PM		SUMNER COUNTY REPORTED GOLFBALL HAIL AND STRONG WINDS.
830 PM		HAM SPOTTERS REPORT WALL CLOUD SE OF MULVANE ALONG SEDGWICK/ SUMNER COUNTY LINE.

APPENDIX F

1991 SPOTTERS' MEETINGS

1/23...GALENA, CHEROKEE COUNTY CONTACT: JERRY ECKHARDT	429-2102	700 PM
1/24...SEDAN, CHAUTAUQUA COUNTY CONTACT: RITA RAYL LOCATION: CHAUTAUQUA COUNTY COURTHOUSE	725-5785	700 PM
2/6....COTTONWOOD FALLS, CHASE COUNTY CONTACT: GERALD INGALLS LOCATION: CHASE COUNTY COURTHOUSE COURTROOM	273-6313	700 PM
2/7....PITTSBURG, CRAWFORD COUNTY CONTACT: ELDON BEDENE LOCATION: MEMORIAL AUD. 9TH AND PINE STS. (BOURBON, NEOSHO, AND LABETTE COUNTIES ALSO INVITED)	724-8274	200 & 600 PM
2/8....IOLA, ALLEN COUNTY CONTACT: RON MOORE LOCATION: ALLEN COUNTY COURTHOUSE	365-5591	700 PM
2/17...KINGMAN, KINGMAN COUNTY CONTACT: DR. EMMETT CHILD LOCATION: (CITY OFFICE BLDG., 324 N. MAIN)	532-2431	700 PM
2/19...HUTCHINSON, RENO COUNTY CONTACT: BILL WALKER LOCATION: RENO COUNTY LAW ENFORCEMENT BLDG.	365-2974	700 PM
2/20...KFDI		515 PM
2/21...INDEPENDENCE, MONTGOMERY COUNTY CONTACT: BILL BOEHME LOCATION: JUDICIAL CENTER 300 E. MAIN	331-2775	200-700 PM

2/25...FREDONIA, WILSON COUNTY CONTACT: CLAYTON CONNELL LOCATION: COURTHOUSE BSMT.	378-2011	700 PM
2/26...WINFIELD, COWLEY COUNTY CONTACT: RANDY DUNCAN LOCATION: STATE HOSPITAL AUD.	221-0470	700 PM
2/28...NEWTON, HARVEY COUNTY CONTACT: LON BULLER LOCATION: HARVEY COUNTY COMMUNITY RM., 8TH AND MAIN	283-6010	700 PM
3/1....HILLSBORO, MARION COUNTY CONTACT: CHARLES PENNER LOCATION: HILLSBORO CITY BLDG CONF. RM.	382-2945	730 PM
3/4....FT. SCOTT, BOURBON COUNTY CONTACT: MARVIN RANKIN LOCATION: FT. SCOTT COLLEGE, RM. 129	223-3800 EXT. 52	700 PM
3/5....WICHITA, SEDGWICK COUNTY CONTACT: JOHN COSLETT LOCATION: CITY COMMISSION RM., CITY BLDG.	383-7546	700 PM
3/6....ERIE, NEOSHO COUNTY CONTACT: JIM KINNE LOCATION: COURTHOUSE, BSMT. MEETING ROOM	244-5781	700 PM
3/7....HUTCHINSON, RENO COUNTY LOCATION: KHCC RADIO STATION		130 PM
3/7....YATES CENTER, WOODSON COUNTY CONTACT: TOM STEWART LOCATION: COMMUNITY BLDG.	625-2135	700 PM
3/11...WELLINGTON, SUMNER COUNTY CONTACT: BERNALD BURROWS LOCATION: RAYMOND FRYE COMPLEX (1/2 BLOCK NORTH OF FIRE STATION)	326-2435	700 PM
3/12...EL DORADO, BUTLER COUNTY CONTACT: VICTOR MARSHALL LOCATION: CITY BLDG. BSMT., 220 E. 1ST	321-9100 EXT. 214	700 PM

3/13...WICHITA, SEDGWICK COUNTY CONTACT: SHERYL CORNELISON, BOEING SECURITY LOCATION: BOEING		1230 PM
3/13...HOWARD, ELK COUNTY CONTACT: JANET LEE LOCATION: EXTENSION OFFICE	374-2108	700 PM
3/14...OSWEGO, LABETTE COUNTY CONTACT: ROB GARTNER LOCATION: COMMUNITY CENTER	795-2995	700 PM
3/18...ATTICA, HARPER COUNTY CONTACT: DAVID MILLER LOCATION: MEMORIAL BUILDING	254-7595	700 PM
3/19...COLWICH, SEDGWICK COUNTY CONTACT: STEVE EDDY LOCATION: CHICAGO (53RD ST) & 6TH ST., RELIGIOUS ED. BLDG.	796-1025	700 PM
3/20...WICHITA, MCCONNELL AFB CONTACT: CAPT. MIKE HUNSUCKER TRAINING TO THE WEATHER DETACHMENT		715 PM
3/21...EUREKA, GREENWOOD COUNTY CONTACT: VIRGIL COX LOCATION: COURTHOUSE HOSPITALITY ROOM	??3-6885	700 PM
4/4....WICHITA, SEDGWICK COUNTY CONTACT: JOHN COSLETT TRAINING TO ALL SHERIFF'S OFFICERS	?23-7546	530 PM

APPENDIX G

NWWS MESSAGE LOG FOR WSFO TOPEKA

Listing begins at 8:30 p.m., April 26 (27/0130 UTC), and works backward to 3:30 p.m., April 26 (26/2130 UTC).

STLSVSSGF	010T	04:27:01:31	STLLFPSTJ	051T	04:27:00:46
TORSVSCNK	228T	04:27:01:31	STLLFPMCI	047T	04:27:00:45
TOPSVSTOP	164T	04:27:01:30	TOPTSTMSG	145T	04:27:00:45
TOPSVSICT	103T	04:27:01:30	TOPSVRICT	201T	04:27:00:44
TOPTORICT	222T	04:27:01:25	TOPSPSTOP	029T	04:27:00:44
TOPLOOTOP	024T	04:27:01:24	STLSPSMCI	032T	04:27:00:43
TOPSEL9	223T	04:27:01:22	TOPSVSCNK	225T	04:27:00:43
TOPSVRICT	207T	04:27:01:22	STLZFPMO	023T	04:27:00:39
TOPTSTMSG	146T	04:27:01:20	TOPSVRICT	200T	04:27:00:38
STLLFPCOU	203T	04:27:01:20	TOPRNSACK	020T	04:27:00:36
STLSVRSGF	081T	04:27:01:19	STLSVSMCI	168T	04:27:00:35
TOPSVRICT	206T	04:27:01:18	STLRNSUMN	065T	04:27:00:35
TOPSVRICT	205T	04:27:01:16	TOPFFSTOP	045T	04:27:00:39
TOPSEL0	107T	04:27:01:16	TOPLFFDDC	043T	04:27:00:34
TOPSVRICT	204T	04:27:01:16	STLSLSMO	072T	04:27:00:33
STLSPSSTL	130T	04:27:01:15	TOPSEL5	114T	04:27:00:32
TOPSPSTOP	031T	04:27:01:15	STLRNSUMN	064T	04:27:00:31
STLSVSSGF	009T	04:27:01:15	TOPSVRTOP	112T	04:27:00:31
TOPSVSCNK	227T	04:07:01:10	STLSLSMO	071T	04:27:00:29
TOPSVRICT	203T	04:27:01:07	TOPTORICT	226T	04:27:00:28
TOPSEL7	119T	04:27:01:06	STLSTPMO	086T	04:27:00:28
STLSFPMO	222T	04:27:01:05	STLSVSSGF	008T	04:27:00:24
STLLFPSOF	004T	04:27:01:04	TOPSVRCNK	115T	04:27:00:24
STLZFPMO	025T	04:27:01:03	TOPSVRTOP	111T	04:27:00:23
TOPSWRKS	214T	04:27:01:03	STLSVSGF	007T	04:27:00:23
TOPSVRTOP	113T	04:27:01:02	TOPSVRCNK	116T	04:27:00:22
TOPTORICT	2271	04:27:01:01	TOPNOWDDC	151T	04:27:00:22
TOPSVRCNK	116T	04:27:00:56	TOPSVRCNK	115T	04:27:00:21
TOPSWRKS	213T	04:27:00:56	TOPTORICT	229T	04:27:00:20
STLZFPMO	024T	04:27:00:54	TOPSTPKS	156T	04:27:00:18
TOPSVSCNK	226T	04:27:00:53	TOPSLSKS	175T	04:27:00:18
STLSLSMO	073T	04:27:00:51	TOPSEL4	104T	04:27:00:18
TOPSFPKS	014T	04:27:00:51	TOPSVRICT	199T	04:27:00:16
STLSVRSOF	030T	04:27:00:50	TOPNOWGLD	215T	04:26:23:59
TOPLFPICT	213T	04:27:00:40	STLCLISTL	019T	04:26:23:57
TOPSPSTOP	030T	04:27:00:49	TOPSWRKS	211T	04:26:23:56
TOPSVRICT	202T	04:27:00:49	STLTORMCI	201T	04:26:23:54
TCPLFPTOP	247T	04:27:00:48	TOPSVRTOP	109T	04:26:23:53
TOPZFPKS	243T	04:27:00:47	STLLFPSTL	122T	04:26:23:50
TOPSEL6	100T	04:27:00:47	TOPSVSTOP	161T	04:26:23:49

TOPTORICT	223T	04:26:23:49	TOPLSRCNK	236T	04:26:22:33
TOPTSTMSG	144T	04:26:23:44	TOPTORTOP	243T	04:26:22:30
TOPSVSTOP	160T	04:26:23:38	TOPTORICT	217T	04:26:22:29
TOPRNSOCK	019T	04:26:23:35	TOPCLITOP	125T	04:26:22:27
TOPLSRCNK	237T	04:26:23:34	STLNOWSTL	103T	04:26:22:24
TOPTORICT	222T	04:26:23:33	TOPSVRTOP	104T	04:26:22:24
TOPSEL2	117T	04:26:23:32	TOPSVSTOP	154T	04:26:22:24
TOPSVRTOP	108T	04:26:23:30	TOPSEL0	106T	04:26:22:24
STLRNSUMN	083T	04:26:23:29	STLSWSMO	160T	04:26:22:22
TOPSPSCNK	130T	04:26:23:29	TOPSVSTOP	153T	04:26:22:19
TOPSVSICT	100T	04:26:23:29	TOPSVSICT	097T	04:26:22:19
TOPTORICT	221T	04:26:23:28	STLCLICOU	203T	04:26:22:18
TOPSPSCNK	129T	04:26:23:28	TOPSPSCNK	127T	04:26:22:16
TOPSPSTOP	028T	04:27:23:25	STLSFPMO	221T	04:26:22:16
TOPTORICT	220T	04:26:23:24	TOPSVSTOP	152T	04:26:22:15
TOPSVSTOP	159T	04:26:23:23	TOPSVSCNK	224T	04:26:22:15
STLSVSMCI	166T	04:26:23:20	TOPTSTMSG	141T	04:26:22:13
TOPTORTOP	245T	04:26:23:10	TOPSVSTOP	151T	04:26:22:12
TOPTSTMSG	143T	04:26:23:13	TOPSVRICT	194T	04:26:22:07
TOPTORICT	219T	04:26:23:12	TOPTORTOP	242T	04:26:22:06
TOPSVSTOP	158T	04:26:23:08	TOPSVRTOP	103T	04:26:22:06
TOPSVSICT	099T	04:26:23:05	TOPSWRKS	208T	04:26:22:03
TOPTORTOP	244T	04:26:23:03	TOPSVSTOP	150T	04:26:22:02
TOPSWRKS	210T	04:26:23:02	TOPNOWGLD	214T	04:26:22:01
TOPSVSTOP	157T	04:26:23:01	STLSPSMCI	027T	04:26:21:58
TOPSWRKS	209T	04:26:22:56	TOPSVSTOP	149T	04:26:21:57
TOPSVRICT	197T	04:26:22:53	TOPSWRKS	207T	04:26:21:56
TOPSVRTOP	107T	04:26:22:51	TOPSVSTOP	140T	04:26:21:53
TOPSPSDDC	229T	04:26:22:50	TOPSVRCNK	114T	04:26:21:51
TOPTORICT	218T	04:26:22:50	TOPSVSTOP	147T	04:26:21:48
TOPSPSCNK	128T	04:26:22:49	TOPSVSICT	096T	04:26:21:47
TOPSVSTOP	156T	04:26:22:46	TOPSVSCNK	223T	04:26:21:46
TOPSEL1	207T	04:26:22:46	TOPTORTOP	241T	04:26:21:45
TOPSVRTOP	106T	04:26:22:46	TOPTSTMSG	140T	04:26:21:43
STLSPSMCI	029T	04:26:22:45	TOPSVSTOP	146T	04:26:21:43
TOPSVSICT	098T	04:26:22:44	TOPRWSKS	137T	04:26:21:43
TOPTSTMSG	142T	04:26:22:43	TOPSVRICT	193T	04:26:21:41
TOPSVRICT	196T	04:26:22:43	STLRNSMCI	106T	04:26:21:40
TOPSVRTOP	105T	04:26:22:41	TOPRNSGCK	017T	04:26:21:39
TOPSVRTOP	155T	04:26:22:39	TOPSVRICT	192T	04:26:21:36
TOPSVRICT	195T	04:26:22:38	TOPSVSTOP	145T	04:26:21:35
TOPRNSGCK	018T	04:26:22:37	TOPSVRICT	191T	04:26:21:31

APPENDIX H

NWWS SUBSCRIBERS IN KANSAS

Name	Contact						
Douglas County Emergency Pre.	Dale Creed	111 E. 11th St.	Lawrene	KS	66044	913-841-7700	1065
Board of Public Utilities	Leon Burtnett	1211 N. 8th St.	Kansas	KS	66101	913-573-9816	1087
KUDL - Shamrock Broadcasting	Darcy Blake	8500 W. 63rd St.	Shawnee	KS	66202	913-722-2866	1170
KCTV 5	Mike Thompson	4500 Shawnee Mission	Fairway	KS	66205	913-677-7234	1119
Knight Riddex Commodity News	David Salmon	POB 6053	Leawood	KS	66206	913-642-7373	2355
Lenexa Police Department	Steve Davidson	12500 W. 87th St.	Lenexa	KS	66215	913-888-4110	1070
City of Junction City	Tom Clark	P.O. Box 287	Junctio	KS	66441	913-762-5912	1573
KJCK Radio	Jerry Brechelsen	P.O. Box 789	Junctio	KS	66441	913-762-5525	1161
KMAN-KMKF	Kevin Block	P.O. Box 1350	Manhatt	KS	66502	913-776-4851	1202
Riley County Civil Defense	Dan Hardin	110 Courthouse Plaza	Manhatt	KS	66502	913-537-6330	1471
Kansas State University	Dean Bark	Bus & Finace Div.	Manhatt	KS	66506	913-532-6270	1026
Div. of Emergency Preparedness	Les Peterson	Adjutant Gen.. Dept.	Topeka	KS	66601	913-266-1422	1078
KSNI-TV	Allen Burbach	P.O. Box 2700	Topeka	KS	66601	913-582-4000	1339
XPL Gas Service	Dave Adams	P.O. Box 889	Topeka	KS	66601	913-296-6463	1047
KTKA-TV	Bob Totten	Box 2229	Topeka	KS	66601	913-234-4949	1523
KTPK	Michael Slocum	910 Bank IV Tower	Topeka	KS	66603	913-267-2300	1381
KHUM Radio	Larry White	1237 Southeast 37th	Topeka	KS	66605	913-267-0960	2293
WIBW TV Radio	Dave Relihan	5600 West 6th St.	Topeka	KS	66606	913-272-3456	1231
Topeka Capital Journal	Mike Blankenship	Jefferson	Topeka	KS	66601	913-295-3200	2193
Kansas Highway Patrol	Andy Scharf	Dept of Admin. Lan	Topeka	KS	66612	913-296-3515	1051C
KTWU Washburn University	Dave Boose	1700 College	Topeka	KS	66621	913-295-6717	1003
Washburn University	Dave W. Boose	Media Center	Topeka	KS	66621	913-295-6717	1370
KOAM TV	Bill Brister	POB 659	Pittsbu	KS	66762	316-342-0400	1077
KVOE-AM/KFFX-FM	Lee Firestone	P.O. Box 968	Emporia	KS	66801	316-342-1400	1067
KFRM	Herb Hoeflicker	2307 West Frontage R	Bellvil	KS	66935	913-527-7118	1454
City of Arkansas	Jim Lazelle	Central and 1st St.	Arkansa	KS	67005	316-442-3344	1064
Cowley County Civil Defense	Randy Duncan	2701 E. 9th St.	Winfiel	KS	67156	316-221-0470	1021
KWCH-TV	Morrill Teller	2815 E. 37th St. N.	Wichita	KS	67201	316-838-1212	1672
Kansas Gas and Electric Co.	Ben Leader	P.O. Box 208	Wichita	KS	67201	316-261-6347	1593
KAKE-TV	Dave Shaeffer	P.O. Box 10	Wichita	KS	67201	316-946-1378	1049
City of Wichita	Paul Taylor	Mtnc Div.-Public Wor	Wichita	KS	67202	316-362-4087	2126
Weather Data, Inc.	Dave Beusterion	825 North Main	Wichita	KS	67203	316-265-9127	1133
KPTS-TV	Dale Hockle	320 W. 21st St.	Wichita	KS	67203	316-838-3090	1397
Cablevision of Parson	Roger Lee	3028 Main	Parsons	KS	67357	316-421-2510	1056
Saline Saline Co. Emergency	Don Roctenwald	Box 1465	Salina	KS	67402	913-827-0326	1060
KCLY FM	Vernadell Yarrow	P.O. Box 16	Clay Ce	KS	67432	913-632-5661	1145
KWHK Radio	Robert Mackey	P.O. Box 1967	Hutchin	KS	67504	316-663-4461	1367
KANS/KQDF AM/FM	Mark Zwing	200 E. 8th Street	Larned	KS	67550	316-285-2127	1106C
KAYS Inc. - Hays Cable TV	Larry Braun	2300 Hall St.	Hays	KS	67601	913-625-2578	2078
KQNK	Larry Black	P.O. Box 220	Norton	KS	67654	913-877-3378	1585
KGNO - KDCK	Jerry Miller	908 Frontview	Dodge C	KS	67801	316-227-4444	1620