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THE BRIEF

FAA - ARTCC
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Welcome to the second season of '*The Brief*'. The CWSU would like to thank all of our customers and partners for their continued interest and input; your feedback helps make this newsletter a success. It is through our shared and collaborative efforts that we learn more about airspace weather impacts, forecast strengths and challenges, and best practices on managing airflow and mitigating hazards.

We will discuss strong winds and their effect at both the surface and aloft in this issue of '*The Brief*', with articles on wind storms and canyon winds. Additionally, we will review a December snow shower event and its impact on Albuquerque approach.

Wind Storms

Gregory Harris, Meteorologist, CWSU Albuquerque, NM

The arrival of Spring heralds longer daylight hours and higher sun angles, producing warmer temperatures across the region. The combination of warm low-level temperatures, and cold air aloft ushered in with the jet stream, makes spring storms volatile (**Figure 1**).

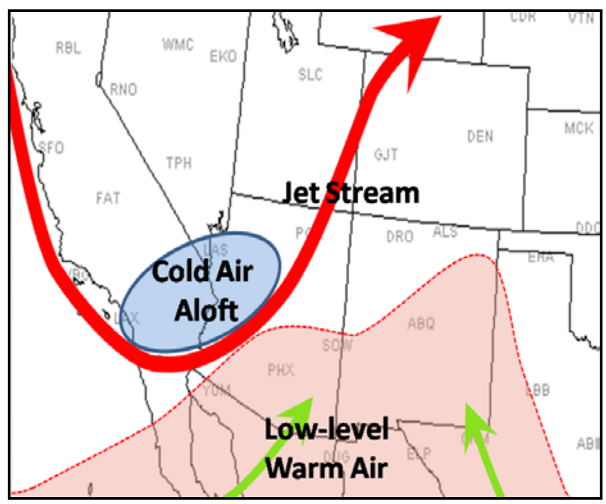

Figure 1.

The cold, dense air aloft sinks and mixes with rising warm air near the earth's surface and produces gusty winds. This mixing may produce sustained winds of 25-35 knots with gusts to 40-50 knots (**Figure 2**). These strong winds can lift dust and sand off the desert floors of southern California, Arizona, and New Mexico, creating a dust storm.

Figure 3 shows a visual satellite image and surface observations from the evening of March 27, 2007. The inset image is from an Arizona Department of Environmental Quality (ADEQ) web camera looking south across Phoenix. A dry cold front produced strong winds across the Southwestern U.S., resulting in widespread blowing dust and sand across the region. The most significant impact was experienced across the deserts of Southeast California and Southwest Arizona, where blowing dust and sand reduced visibility to less than a mile. Aircraft reported reduced visibility from the surface to 5000 feet, and the Aviation Weather Center (AWC) issued an IFR SIGMET for the region.

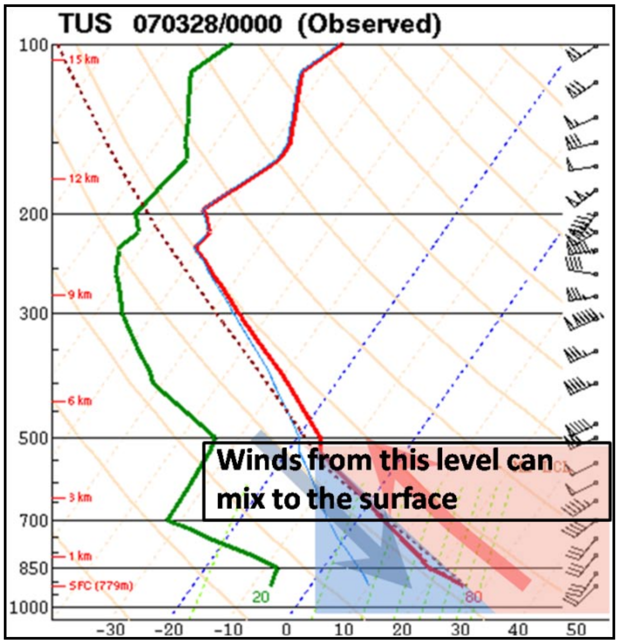

Figure 2. 28MAR07 00Z Upper Air Sounding, Tucson, AZ

Low-level weather hazards were not the only concern for controllers. Jet stream and upper-level winds were strong and turbulent. Southwest winds at 18,000 feet, along the ARLIN approach stream, increased from 40 knots at 12Z to about 100 knots by 00Z (**Figure 4**). This impacted the northeast BUNTR and EAGUL approach streams, where reports of continuous moderate and greater turbulence were reported with strong head winds.

On the ground, PHX was experiencing strong, westerly surface winds sustained at 28kts gusting to 38kts. For most of the day surface and slant visibilities remained well above six statute miles, but as the sun began to set and the evening traffic push began, blowing sand and dust moved over the PHX area (**Figure 5**). The low sun angle significantly reduced slant visibilities and pilots' ability to see the PHX runway on approach.

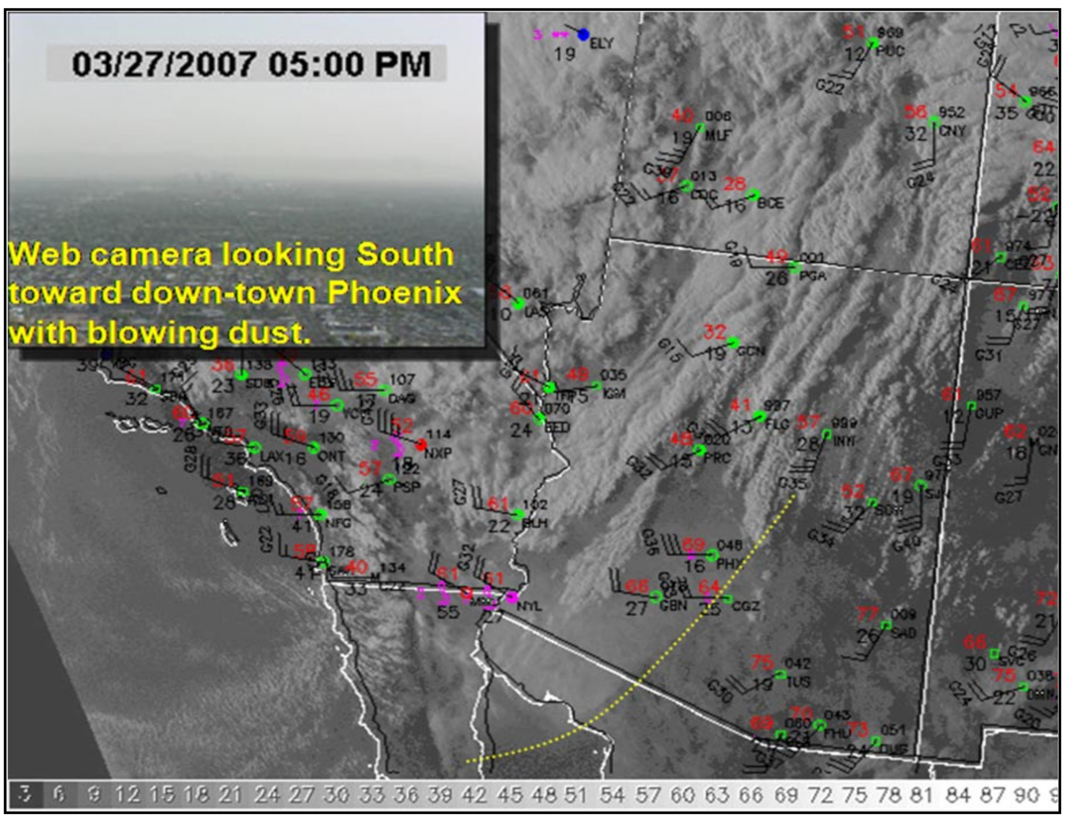

Figure 3. 28MAR07 0115Z VIS Satellite and 0143Z observations (ADEQ inset)

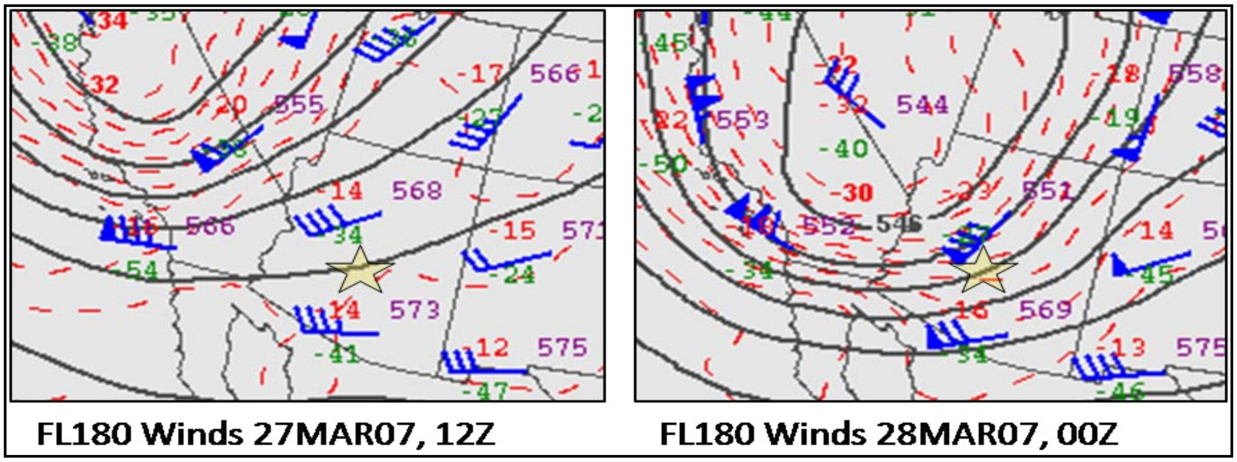

Figure 4. Upper-level Trough and Strengthening ~FL180 Winds

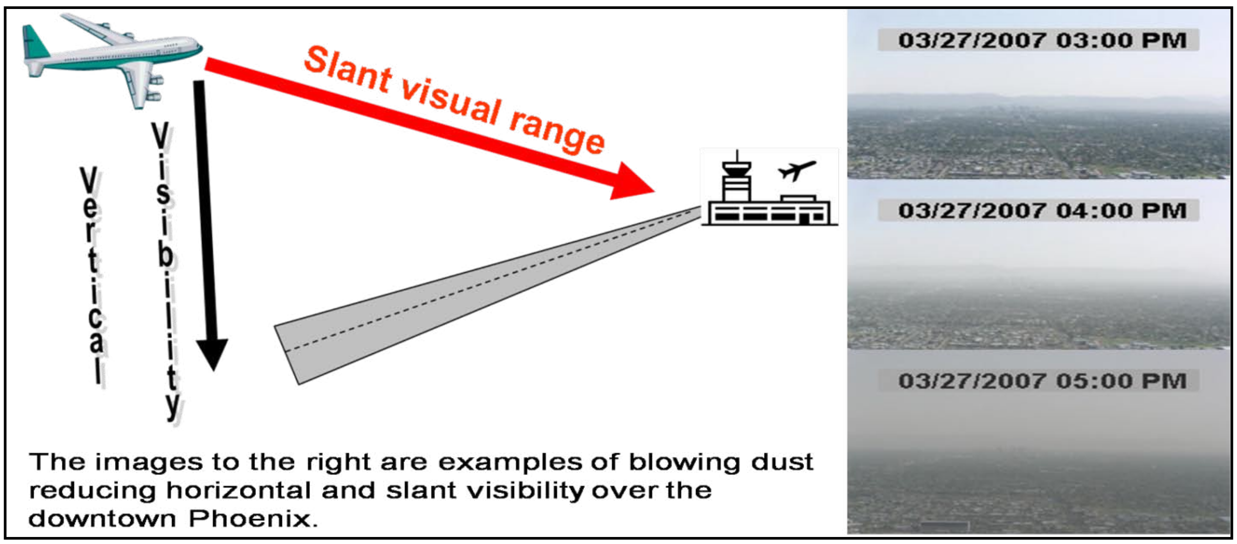

Figure 5. ADEQ Web Camera Images of Downtown Phoenix

Strong frontal systems can produce a variety of significant weather for both en-route aircraft and terminal operations. Strong winds in the Southwest are capable of producing the following conditions:

- Blowing dust and sand
- Reduced visibilities
    - Surface
    - Flight level
    - Slant-wise visibility on approach
- Turbulence and Low-level wind shear

Impacts on air traffic include:

- TRACON
    - Loss of visual separation
    - Decreased arrival/departure acceptance rates
- Terminal - ATCT
    - ILS approach
    - Disruption to ground operations

Local East Canyon Winds

Neil Haley, Meteorologist, CWSU Albuquerque, NM

From fall through early spring, cold fronts can reach deep into the southern plains of the United States. At times these fronts will "back-up", or spread down to New Mexico's central mountain chain. If the cold air is deep enough, it will spill through the passes and canyons creating locally strong east canyon winds along the Rio Grande Valley. Albuquerque Sunport and Santa Fe Municipal are the two airports most affected by this phenomenon. They are positioned below Tijeras Canyon and Glorietta Pass respectively.

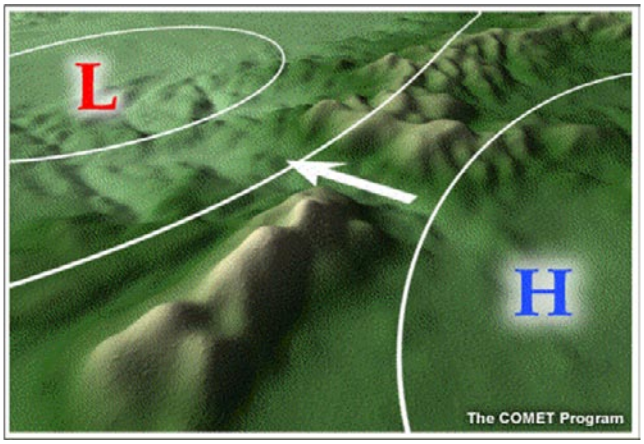

Figure 6.

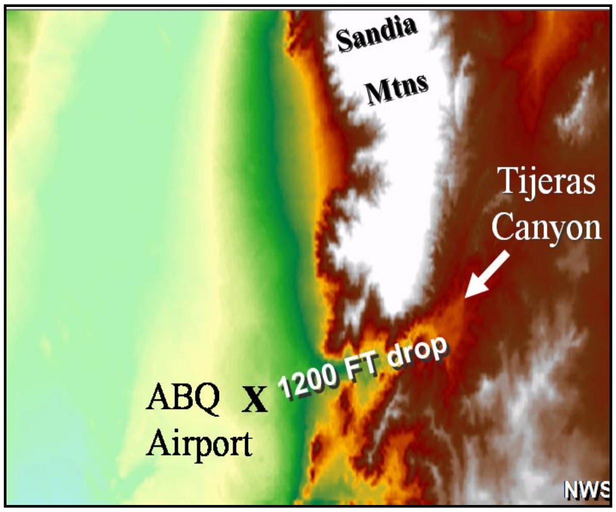

Figure 7.

The winds are caused by a buildup of cold, dense air on the east side of the Sangre de Cristo, Sandia, and Manzano Mountain Ranges. The deeper the cold air mass, the stronger the winds. As seen in **Figure 6**, wind flows from high pressure (represented by an 'H') to low pressure, getting squeezed through the mountain pass. For canyon winds to be significant, the cold air mass behind the front must build to at least 6700 ft above mean sea level (MSL) at Glorietta pass and at least 7200 ft MSL at Tijeras canyon (**Figure 7**). Cold air descends through the canyon much like water pouring through a breached dam, reaching highest velocity as it exits the canyon. For Albuquerque, this is near I-40 and Tramway; east winds commonly range between 15-35 knots and gust to 50 knots in this area during these events. The winds fan out from the base of the canyon and gradually decrease as they travel west.

Surface heating across the Rio Grande Valley can hinder daytime occurrence of canyon winds; after sunset however, the cold canyon air is released. The NWS Forecast Office has developed some general rules-of-thumb for canyon winds at Albuquerque Sunport (ABQ), which include:

Timing

- 2-3 hours after gap winds begin in Santa Fe, NM (SAF).

  Or

- 1-2 hours after strong easterly component winds begin at Clines Corners (CQC).

Strength

- Roughly double the Clines Corners or SAF wind speed.

For example, if the post-frontal wind at CQC is 04012G18kt at 2015Z, then expect a wind around 09024G36kt at ABQ shortly after 2115Z—if the cold air mass is deep enough to fill the canyon. Again, as mentioned on the previous page, significant daytime heating/mixing may delay the onset of the canyon, or "gap", winds until late evening.

Canyon winds are shallow, often confined below 2000 feet AGL. Winds above this strong low-level flow generally remain westerly. Changes of wind speed and direction in the layer between an east canyon wind and the west flow aloft produces low-level wind shear and turbulence. The strong east wind moving across rugged terrain also generates low-level turbulence. Considering the complexities involved, anticipating and avoiding canyon winds can be tricky, especially for pilots with little experience flying in complex terrain. Aviation interests should pay close attention to local TAFs when a cold front moves into New Mexico. Highlights to keep in mind:

- High impact on ABQ and SAF airports
- Stronger events also reach Double Eagle, Taos, and Grants Airports
- Very strong, "Over-the-top" events can cause hurricane-force winds in Albuquerque
  - *108 mph (gust) - 1990 - Glenwood Hills (at Montgomery and Tramway)*
  - *124 mph (gust) - 1987 - tram base*
  - *90 mph (sustained) - 1943 - Albuquerque Airport*

Albuquerque Snow Squall

Neil Haley and Gregory Harris, Meteorologists, CWSU Albuquerque, NM

During the late afternoon and early evening hours of December 21st 2007, an upper-level disturbance moved east of Phoenix and started producing rain showers with isolated embedded thunderstorms. This weather system maintained intensity, eventually generating a rain-snow mix as it encountered colder ambient temperatures east of the Continental Divide and into New Mexico's Rio Grande Valley. One thunderstorm over South Albuquerque produced 15-20 knot southwest winds with gusts to 33 knots at Albuquerque Sunport Airport (ABQ). This wind shift caused seven aircraft diversions between 2140Z and 2235Z, six to Amarillo, TX and one to Lubbock, TX. Before discussing the event further, it is important to preview ABQ's airport diagram and equipment.

Albuquerque can utilize two different runways, 08-26 and 03-21, shown in red and green on Figure 8. Runway 17-35 is closed and slated for removal. Aircraft arriving from the west or southwest (8/3) can use an instrument-based landing system (ILS); all other landings are covered by RNAV (GPS) approach only. Another important fact regarding Runway 3 involves its visibility instrumentation and Runway Visual Range (RVR) transmission. The RVR signal for Runway 3 is issued on a microwave transmitter, which degrades in heavy snowfall or dense fog. Unlike Runway 3, the Runway 8 signal is hard-wired and becomes the sole ILS approach available during low visibility conditions.

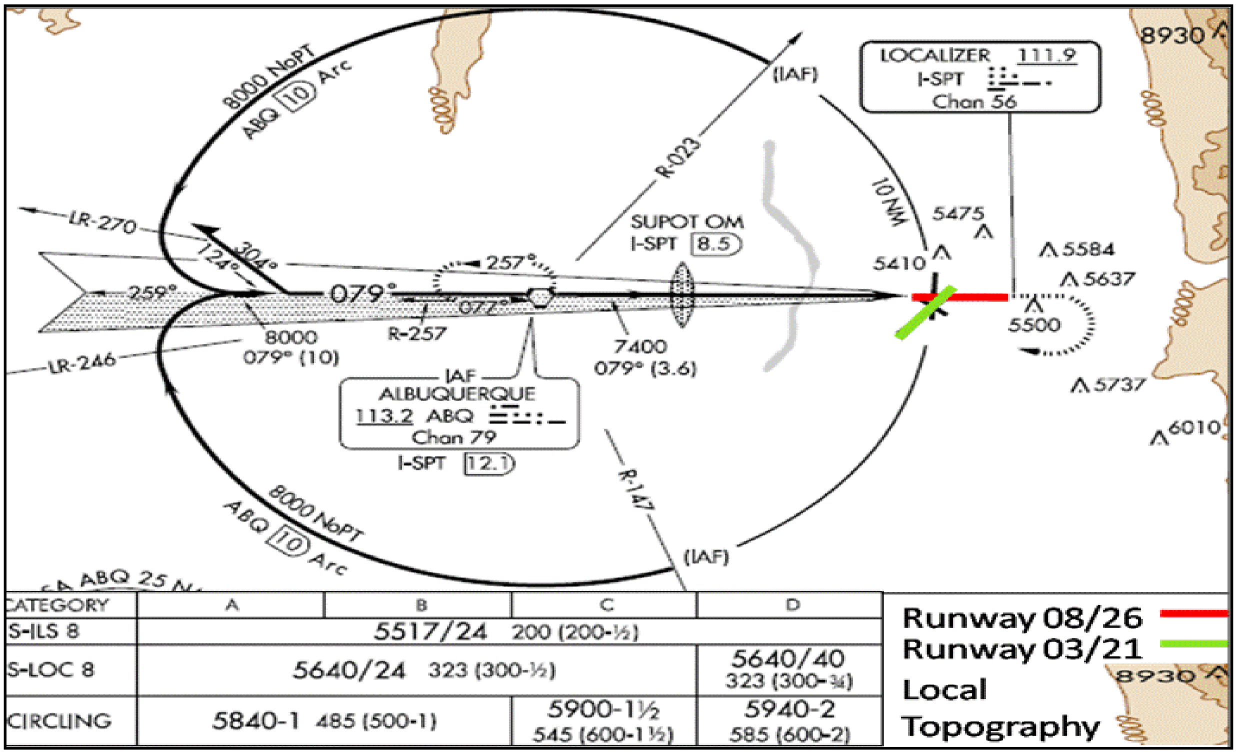

Figure 8. ABQ Runway 08 Approach Plate (see Table 3 for format explanations)

Now let's take a look at how weather created a significant operational impact on arrivals at ABQ on December 21st. **Table 1** shows surface observation information from 1856Z through 2356Z, along with runway configuration, tailwind, and flight category (please see **Table 2** on the following page for flight category definitions).

Table 1. ABQ Weather Trend

Time (Z)	Flight Category	Wind Dir/Speed (KT)	Tailwind (KT)*	Visibility (SM)	Weather	Ceiling (Ft AGL)	Runway
1856	VFR	22007		10	None	8000	26
1956	VFR	24009		10	None	7500	26
2056	VFR	23012		10	-RA	3200	26
2111	MVFR	22011		10	-RA	2600	08
2142	MVFR	24020G33	≈ 24	4	-TSRASN	1700	08
2147	MVFR	24019G31 [+]PW 33	≈ 23	6	-TSSN	1400	08
2156	MVFR	25019G30 [+]PW 33	≈ 22	3	-TSSN BR	1400 CB	08
2207	IFR	23014G25 [+]PW 26	≈ 19	2	-SN BR	1100	08
2215	IFR	22012 [+]PW 26	≈ 18	1	-SN BR	800	08
2227	LIFR	22014G20 [+]PW 26	≈ 19	¾	-SN BR	600	08
2238	LIFR	20011 [+]PW 26	≈ 13	¾	-SN BR	1100	08
2241	MVFR	19010 [+]PW 26	≈ 11	3	-SN BR	1700	08
2256	MVFR	20008 [+]PW 26	≈ 10	10		2500	08
2335	IFR	33019G23		1 ½	-SN BR	1700	08
2339	IFR	34017		1	-SN BR	1200	08
2342	LIFR	34017		¾	-SN BR	1200	08
2356	MVFR	34012		5	-SN BR	2000	08
2358	IFR	34011		1 ½	-SN BR	1200	08

[+] PW = Peak Wind Report. Located in remarks section of observation.
* Note: Tail winds were approximated from prevailing and peak wind reports.

Table 2. Flight Category Definitions

Category	Ceiling		Visibility
Visual Flight Rules (VFR)+	greater than 3,000 feet AGL	and	greater than 5 miles
Marginal Visual Flight Rules (MVFR)	1,000 to 3,000 feet AGL	and/or	3 to 5 miles
Instrument Flight Rules (IFR)	500 to below 1,000 feet AGL	and/or	1 mile to less than 3 miles
Low Instrument Flight Rules (LIFR)*	below 500 feet AGL	and/or	less than 1 mile
*By definition, IFR is ceiling less than 1,000 feet AGL and/or visibility less than 3 miles while LIFR is a sub-category of IFR. +By definition, VFR is ceiling greater than or equal to 3,000 feet AGL and visibility greater than or equal to 5 miles while MVFR is a sub-category of VFR.			

Note that the flight category for ABQ dropped from Visual Flight Rules (VFR) to Instrument Flight Rules (IFR) between 2056Z and 2207Z due to lowered visibility/ceiling, requiring an ILS approach on either Runway 3 or 8. Furthermore, the RVR transmission for Runway 3 was degraded due to snowfall and fog (-SN BR), forcing controllers and pilots to use Runway 8. This new configuration allowed pilots to shoot ILS approaches, but unfortunately put them in an unsafe position with gusty tailwinds on final approach. As noted in the *FAA Order 8400*.9 excerpt below, tailwinds compromise the safety of aircraft using the runway and should not exceed 7 knots unless runway length allows, as determined by the Flight Standards District Office. In addition, wet runways further complicated the situation at ABQ; FAA guidelines recommend tailwinds of no more than 3 knots in slippery conditions.

FAA Order 8400.9: National Safety and Operational Criteria for Runway Use Programs: Section 7: OPERATIONAL SAFETY CRITERIA FOR RUNWAY USE PROGRAMS

The following criteria shall be applied to all runway use programs:

…

d. Winds

(1) Clear and dry runways

…

(b) Except for (c) below, the ***tailwind component must not be greater than 5 Knots****.*

(c) Where anemometers are installed near the touchdown zone of the candidate runway for landings, or near the departure end for takeoffs, ***any tailwind component must not be greater than 7 Knots.***

(2) Runways not clear or not dry

…

(b) ***No tailwind*** *component may be present except for the nominal range of winds reported as calm (0-3 Knots) may be considered to have no tailwind component.*

(a) Unless otherwise approved by the applicable FAA Flight Standards office based on runway available and field lengths required for aircraft normally using the runway, the runway must be grooved or have a porous friction coarse surface.

As the afternoon of December 21st wore on, strong winds and low visibility continued to jeopardize the safety of aircraft approaching Albuquerque's airspace. Tower controllers were even having difficulty seeing the runway during periods of heaviest snowfall, and visibilities were occasionally below circling minimums (see **Table 4**), further compounding operational issues. The best decision available to controllers at times was to divert aircraft to alternate airports, rather than permit a difficult approach into ABQ. These "go/no-go" decisions needed to be made quickly, because the nearest viable alternate destinations for some air carriers were over two hundred miles away in Texas and required the use of substantial fuel.

Table 3. Landing Minimum Format

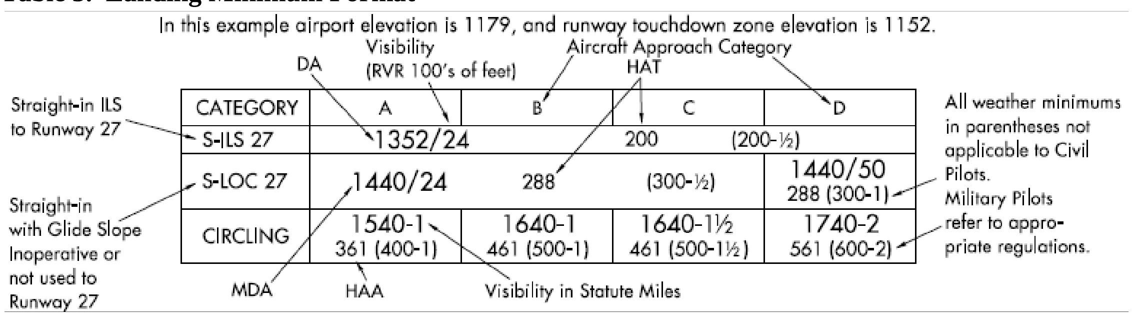

Table 4. Radar Instrument Approach Minimums

RADAR INSTRUMENT APPROACH MINIMUMS

ALBUQUERQUE, NM Amdt. 20C, MAY 17, 2002 (FAA) ELEV **5355**

ALBUQUERQUE INTL SUNPORT

RADAR - 123.9 354.1

	RWY GS/TCH/RPI	CAT	DA/ MDA-VIS	HAT/ HAA	CEIL-VIS	CAT	DA/ MDA-VIS	HAT/ HAA	CEIL-VIS
ASR	8	ABC	**5700**/24	384	(400-½)	DE	**5700**/50	384	(400-1)
	35	ABC	**5700**-1	386	(400-1)	DE	**5700**-1¼	386	(400-1¼)
	3	ABC	**5700**-1	388	(400-1)	DE	**5700**-1¼	388	(400-1¼)
	17	AB	**5740**-1	419	(400-1)	CD	**5740**-1¼	419	(400-1¼)
		E	**5740**-1½	419	(400-1½)				
CIRCLING		AB	**5840**-1	488	(500-1)	C	**5900**-1½	545	(600-1½)
		D	**5940**-2	585	(600-2)	E	**6040**-2½	685	(700-1½)

Circling Category E not authorized E of Rwys 17/35. CAUTION: Steeply rising terrain in NE quadrant exceeding 8000' at 8 NM from airport and in SE quadrant exceeding 6300' at 4.6 NM from airport. Categories D and E S-8 visibility increased to RVR 6000 for inoperative MALSR.

*   *   *