National Transportation Safety Board

Office of Aviation Safety
Washington, D.C. 20594-2000
November 25, 2009

ADDENDUM 1 - METEOROLOGICAL FACTUAL REPORT

LAX08PA259

A. ACCIDENT

Location: Weaverville, California
Date: August 5, 2008
Time: 1941 Pacific daylight time (0241 UTC[1] August 6, 2008)
Aircraft: Sikorsky S-61N helicopter, registration: N612AZ

B. METEOROLOGICAL SPECIALIST

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C. SUMMARY

On August 5, 2008, about 1941 Pacific daylight time (PDT), a Sikorsky S-61N helicopter, N612AZ, registered to Carson Helicopters Incorporated and under contract to the United States Forest Service, impacted trees and terrain during initial climb after takeoff in the Shasta-Trinity Forest near Weaverville, California, while performing a forest fire support mission. The airline transport pilot, the safety crewmember and seven firefighters were killed; the commercial copilot and three firefighters were seriously injured. The helicopter was consumed by post impact fire, which burned for two days. The U.S. Forest Service firefighting support mission was being conducted as a Public Use operation.

[1] UTC – is an abbreviation for Coordinated Universal Time.

D. DETAILS OF INVESTIGATION

The following addendum is submitted to support the Meteorological Factual Report dated June 15, 2009, and answer questions from the parties on this investigation. New data is also included to add clarity to the report.

1.0 Additional Observation Data

No weather observations were available at the H-44 landing zone other than a crude wind indicator consisting of ribbons tied to several trees at approximately 5 to 6 feet above the ground near the landing zone. Therefore the surrounding area was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and from United States Forest Service (USFS) Remote Automatic Weather Station (RAWS)[2] observations. Cloud heights are reported above ground level (agl).

1.0.1 Redding Municipal Airport (KRDD), Redding, California

The closest weather reporting facility to the accident site was from Redding Municipal Airport (KRDD), Redding, California, located approximately 50 miles east-southeast of the accident site at an elevation of 505 feet msl. The airport was equipped with an Automated Surface Observation System (ASOS).

The closest observation to the time of the accident from KRDD was at 1953 PDT (0253Z), and indicated winds from 150° at 7 knots, visibility 10 statute miles, ceiling broken at 17,000 feet agl, temperature 33° C, dew point 2° C, altimeter 29.83 inches of Mercury (Hg). Remarks: automated observation system, sea level pressure 1009.6-hPa, temperature 33.3° C, dew point 1.7° C, and 3-hour pressure tendency increasing 0.1-hPa.

A review of the observations indicated a maximum temperature of 37.2° C (99° F) was reported in the 1653 PDT observation, approximately 3 hours prior to the accident.

1.0.2 Backbone Ridge (BABC1)

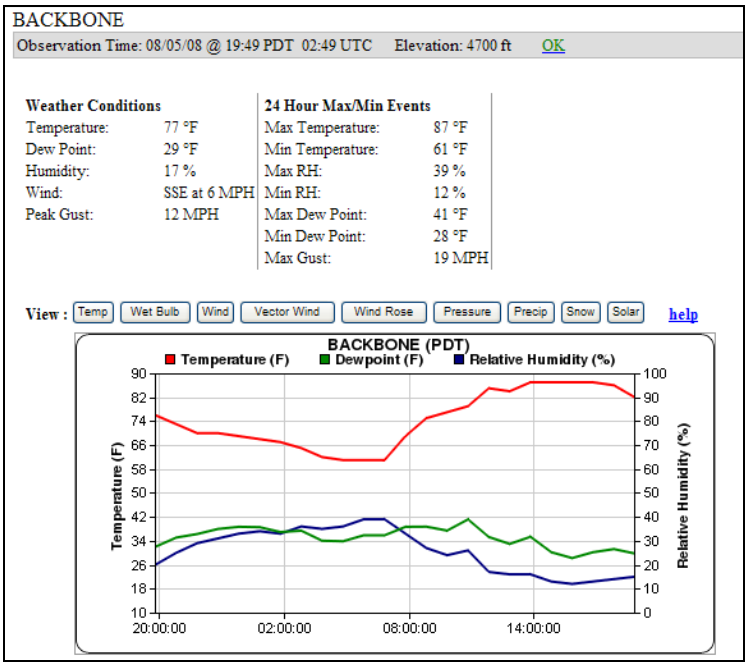
The USFS RAWS site at Backbone (BABC1) was located on the top of Backbone Ridge at an elevation of 4,700 feet msl, located near China Springs, California, approximately 6 miles east-southeast of the accident site. The RAWS network typically provides hourly values of air temperature, dew point, relative humidity, wind speed, wind direction, precipitation, fuel temperature, and fuel moisture. The RAWS reported the following conditions surrounding the period:

[2] There are approximately 2,200 Remote Automated Weather Systems (RAWS) strategically located throughout the United States. These stations monitor the weather and provide weather data that assists land management agencies with a variety of projects such as monitoring air quality, rating fire danger, and providing information for research applications.

Backbone	Time (PDT)	Temp (°F)	Dew (°F)	Wet Bulb (°F)	RH (%)	Wind (dir/mph)
	1649	87.0	30.2	56.1	13	SSE 6
	1749	86.0	31.2	56.0	14	ESE 3
	1849	82.0	29.8	54.1	15	SSE 5
	1949	77.0	28.8	51.9	17	SSE 6
	2049	72.0	33.2	51.3	24	SSE 9

* High temperature reported for the 24-hour period 87° F (30.5° C).

At the approximate time of the accident, Backbone Ridge reported a temperature of 25° C (77° F), with a maximum temp 30.5°C (87° F) reported at 1649 PDT. Wind was from the south-southeast at 5 knots. Below is the 1949 PDT observation with a 24-hour meteogram of temperature, dew point temperature, and relative humidity following the accident.



1.0.3 Big Bar (BGBC1)

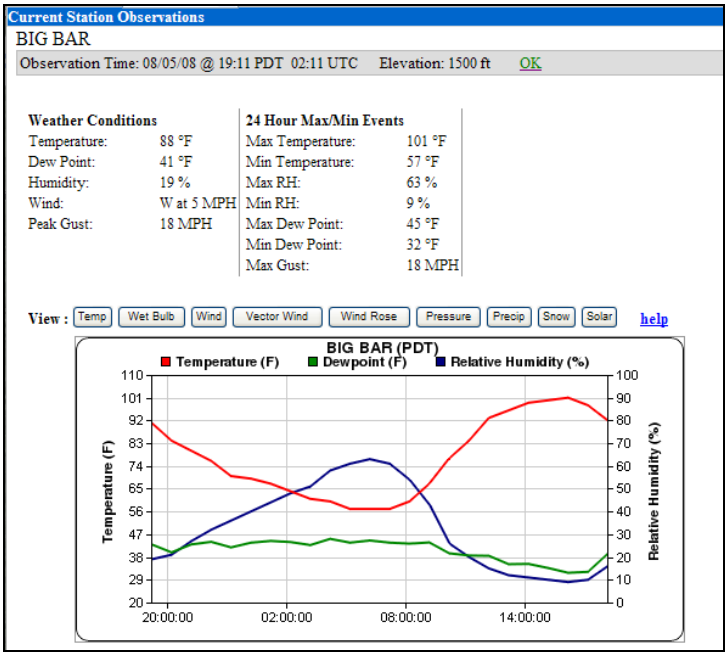
The NWS RAWS site at Big Bar (BGBC1) was located off highway 299, and near the Trinity River and Manzanita Creek at an elevation of 1,500 feet msl, located near Big Bar, California, approximately 10 miles south of the accident site. The RAWS reported the following conditions surrounding the period:

Big Bar	Time (PDT)	Temp (°F)	Dew (°F)	RH (%)	Wind
	1611	101.0	31.8	9	SW 2
	1711	98.0	32.1	10	ESE 3

	1811	92.0	39.3	16	WNW 6
	1911	88.0	40.5	19	W 5
Interpolation	1941	86.0	40.0	20	W 4
	2011	84.0	41.0	22	WNW 2

* High temperature reported for the 24-hour period 101° F.

At the time of the accident, the temperature at Big Bar was approximately 30° C (86° F), with a maximum temperature earlier reported at 38.3° C (101° F). Wind was from the west to west-northwest at 4 knots or less. The Big Bar observation and meteogram follows.

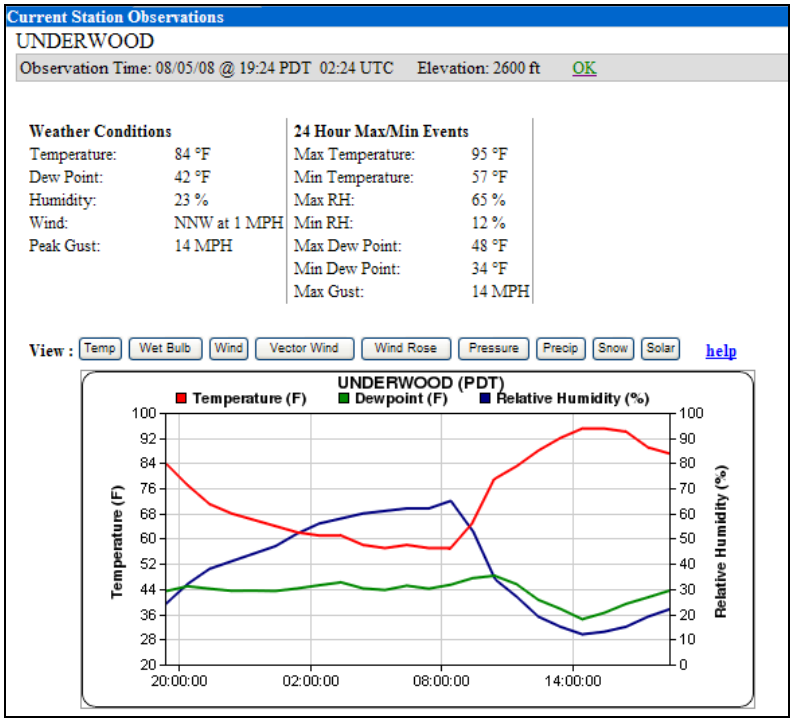


1.0.4 Underwood RAWS

Underwood RAWS (UDWC1) was located 16 miles southwest of H-44 at an elevation of 2,600 feet. The following conditions were reported during the period.

Underwood	Time (PDT)	Temp (°F)	Dew (°F)	RH (%)	Wind (dir/mph)
	1624	94.0	39.3	15	NW 4
	1724	89.0	41.4	19	NW 3
	1824	87.0	43.5	22	W 3
	1924	84.0	42.2	23	NW 1
Interpolated	1941	80.0	43.0	25	Calm
	2024	77.0	44.9	32	SW 1

Temperature at the time of the accident was approximately 27.0° C (80° F), with a high temperature of 34.5° C (94° F) at 1624 PDT. Wind was under 3 knots or calm surrounding the period.



1.0.5 SRF53 Portable RAWS (TR151)

SRF53 Portable RAWS was located 16 miles west of the accident site at an elevation of 615 feet. The SRF53 observation and meteogram are as follows:

SRF53	Time (PDT)	Temp (°F)	Dew (°F)	RH (%)	Wind (dir/mph)
	1601	98.0	42.4	15	Calm
	1701	99.0	43.2	15	Calm
	1801	94.0	44.0	18	Calm
	1901	87.0	42.3	21	Calm
Interpolated	1941	85.0	42.0	25	Calm
	2001	81.0	45.7	29	Calm

At the approximate time of the accident the temperature was 85° F or 29.5° C, with calm winds during the period.

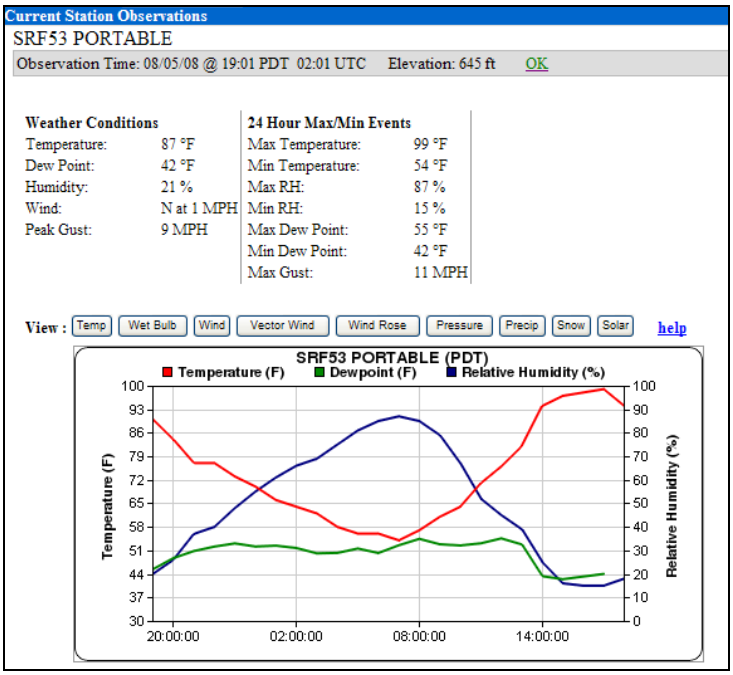


Figure 7 – SRF53 Portable RAWS

1.0.6 Trinity Base (TCAC1)

Trinity Base (TCAC1) was located approximately 22 miles east-southeast of the accident site on the southern side of Trinity Lake near the dam at an elevation of 3,207 feet. Figure 8 is the observation near the time of the accident and meteogram. The Trinity Base data surrounding the period were as follows:

Trinity Base	Time (PDT)	Temp (°F)	Dew (°F)	RH (%)	Atl (“Hg)	Wind (dir/mph)
	1650	86.0	25.4	11	29.97	E 10
	1750	86.0	23.1	10	29.97	E 7
	1850	82.0	20.1	10	29.96	E 6
	1950	81.0	23.6	12	29.27	ESE 3
	2050	77.0	20.5	12	29.98	ESE 3

At 1950 PDT Trinity Base reported a temperature of 27° C, with a high temperature of 30.5° C (87° F) reported prior to 1650 PDT. Winds were from the east-southeast at 2 knots or by definition calm.

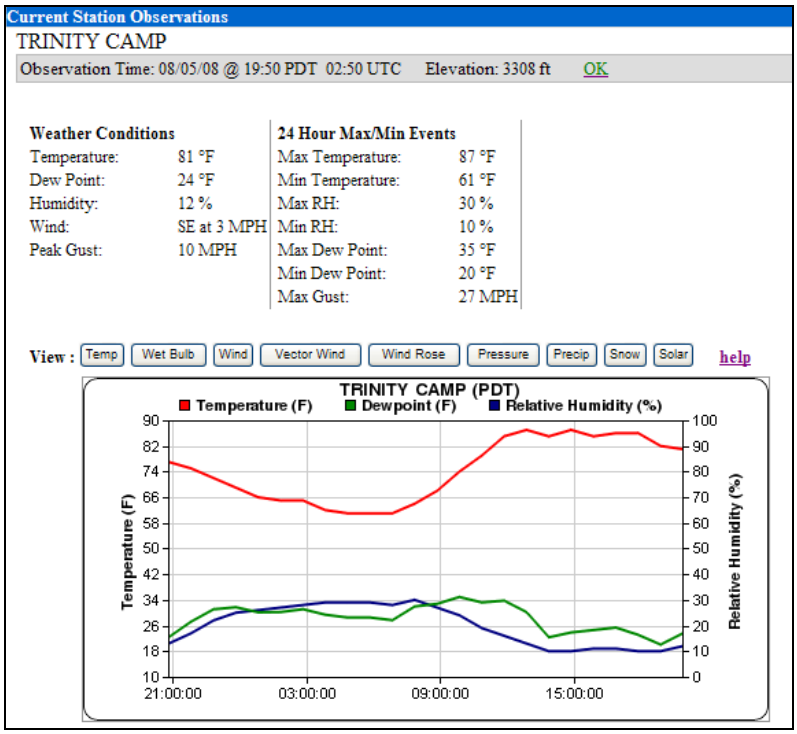


Figure 8 – Trinity Base RAWS

Figure 1 is a plot of all the surrounding observations included from the University of Utah's MesoWest website for 2000 PDT on August 5, 2008, over a topographical chart for the region. The images include the RAWS observation sites with temperature (°F) and wind direction and speed (mph) shown by the wind barb, with no barb indicating calm conditions, and the approximate location of the accident site marked by the cross.

The plot of the observations depicts a cyclonic circulation in the immediate vicinity of the accident site with sustained wind speeds of 5 knots or less over the area. A review of the RAWS observations also depicted decreasing wind speeds into the evening, which would be typically expected with decreasing temperatures.

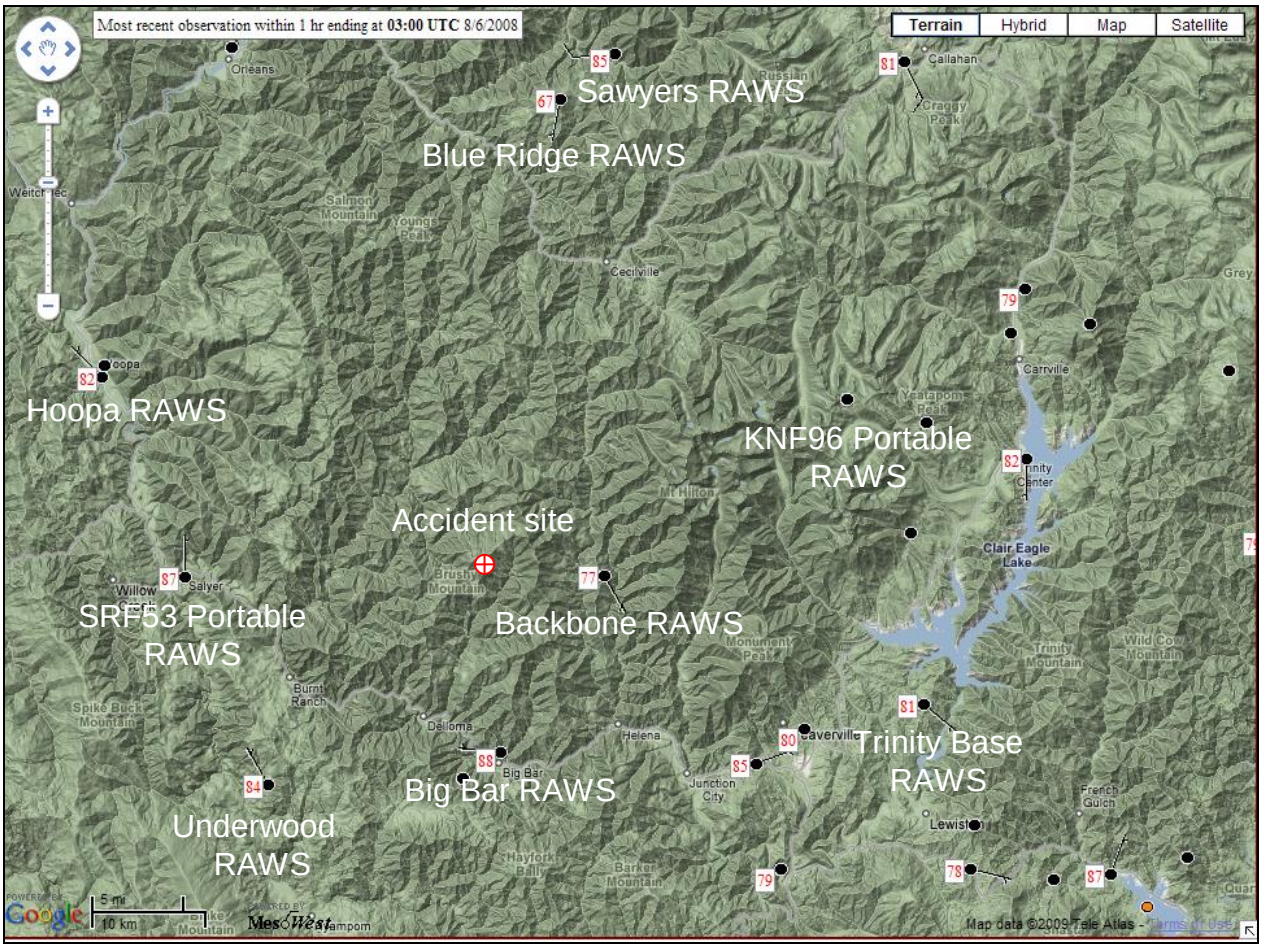


Figure 1 – Mesowest RAWS sites at 2000 PDT

2.0 Model Data

The NOAA Air Resources Laboratory (ARL) archive North American Mesoscale (NAM) Model data for 2000 PDT (0300Z on August 6, 2008) over the accident site is included as figure 2, plotted on a Skew-t log-P diagram, with temperature in red and dew point temperature in green. The wind profile is on the right side of the diagram. The model had a resolution of 12 kilometers or 6 ½ miles. While the model includes terrain data, it could not accurately resolve all the local variations, as in this case, it depicts conditions below the elevation of the accident site. The model depicted the highest temperature of 23.2° C at 875-hPa or 4,120 feet. At 825-hPa or 5,800 feet the temperature was 20.9° C.

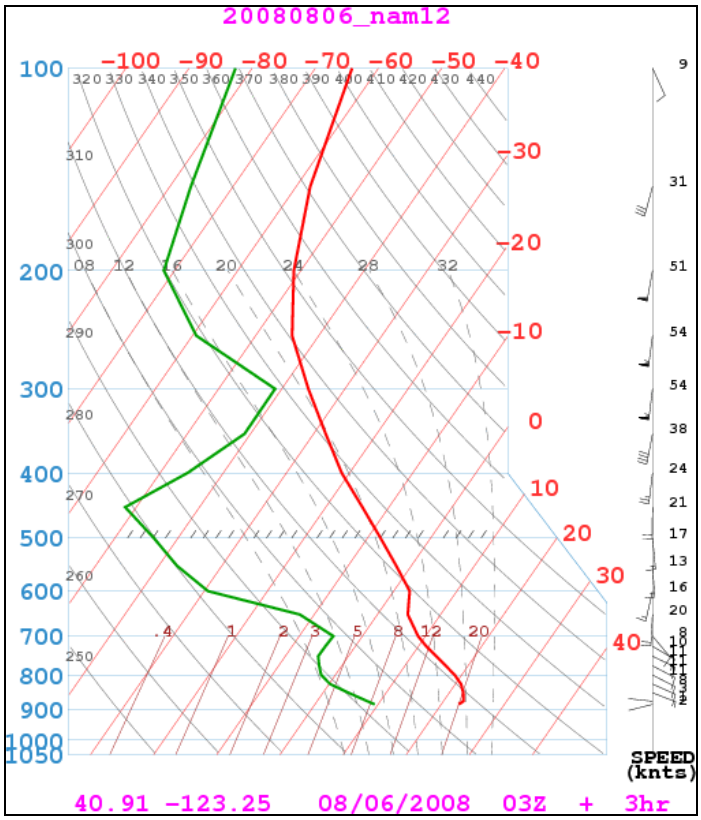


Figure 2 – ARL Forecast sounding over accident site for 2000 PDT

Pressure (hPa)	Height (msl)	Temperature (°C)	Dewpoint (°C)	Wind (Dir/KT)	RH (%)
884	3,840	22.8	9.4	calm	40
875	4,120	23.2	8.0	calm	38
850	4,950	22.2	4.0	110° 4	31
825	5,800	20.9	0.2	110° 8	25
800	6,670	18.9	-2.2	110° 12	24
775	7,560	16.5	-3.6	110° 12	25
750	8,460	13.9	-4.8	110° 12	27
725	9,400	11.3	-4.7	110° 10	33
700	10,350	8.8	-4.6	130° 10	39

The model depicted surface wind from the west that shifted to the east-southeast immediately above the surface with wind speeds less than 5 knots below 5,000 feet. At 5,800 feet or 825-hPa the model depicted wind from 110 at 8 knots, which was stronger than recorded at any of the surrounding RAWS observations or reported by any of the witness at H-44.

Figure 3 is the NAM model depicting the surface wind streamlines for 2000 PDT (0300Z). The streamline analysis depicts an area of confluence over the accident site consistent with that of the

trough of low pressure with winds converging from the west and the east-southeast in the vicinity of the accident site.

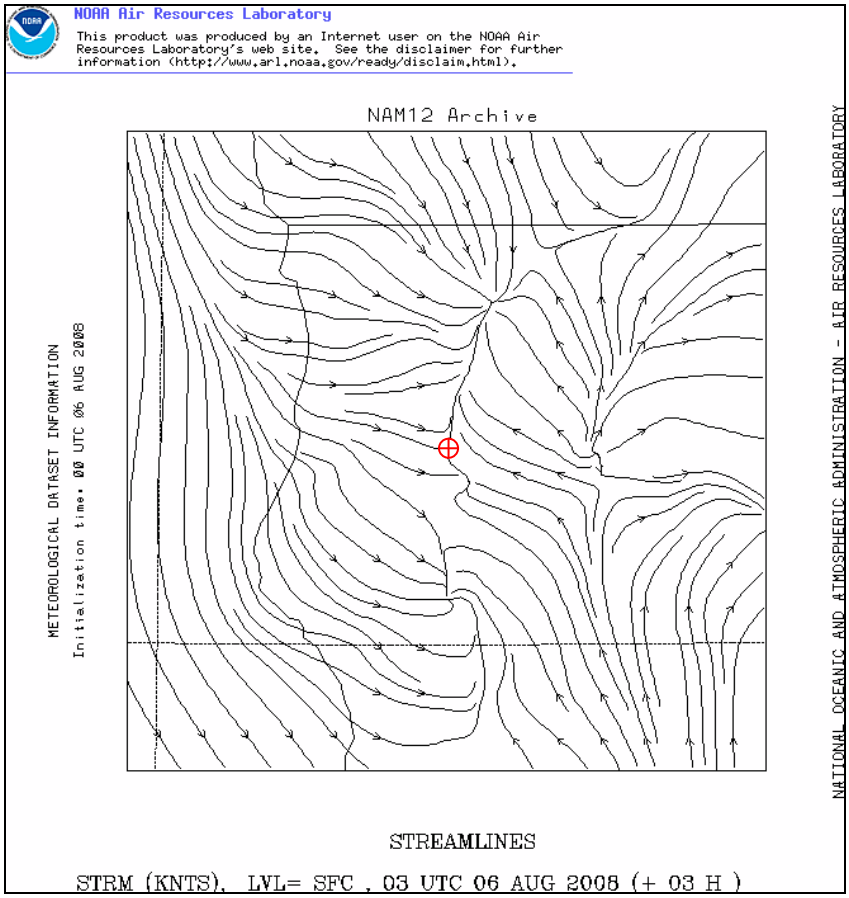


Figure 3 – NAM surface streamlines for 2000 PDT

The NAM surface temperatures for 1700 PDT (0000Z) and at 2000 PDT (0300Z) are included as figures 4 and 5 respectively. The data shows a surface temperature or 2 meter temperature between 28° and 29° C in the vicinity of the accident site at 1700 PDT and between 22° and 23° C at 2000 PDT.

Figure 6 is the NAM model temperature and wind vector at 825-hPa or a pressure altitude of 5,800 feet. The model depicted a temperature of 20° to 21° C with a wind from the east to southeast at approximately 5 knots. The model did not depict the cyclonic circulation as indicated by the RAWS data in figure 1at the surface.

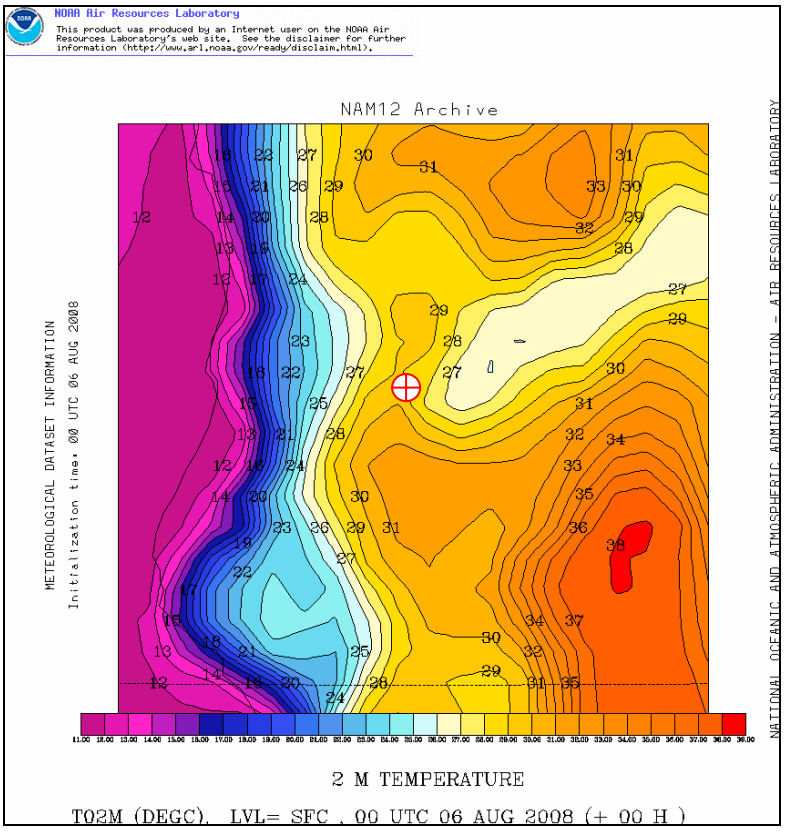


Figure 4 – NAM surface temperatures for 1700 PDT

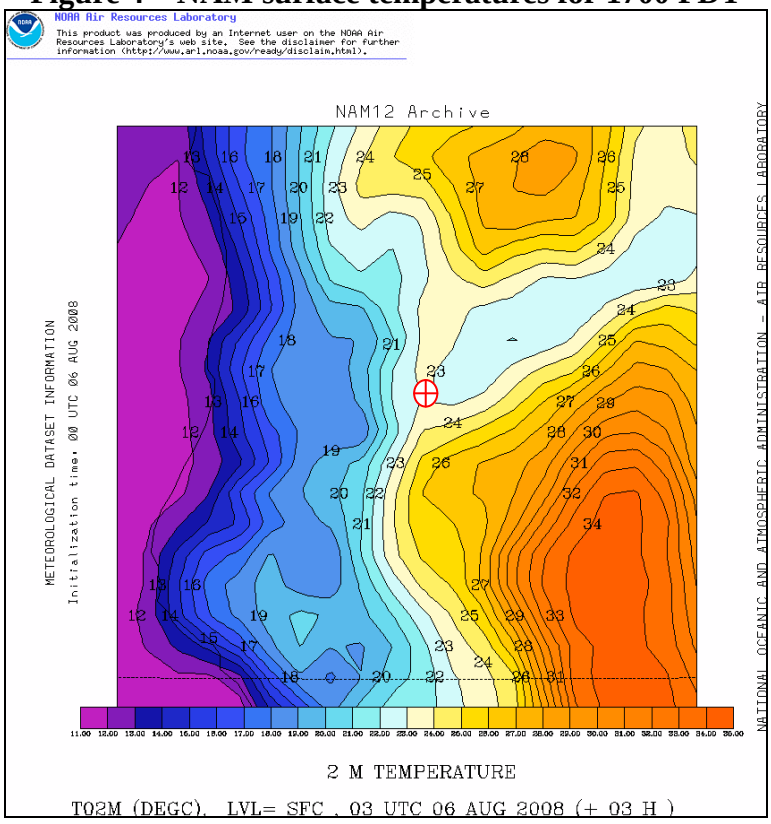


Figure 5 – NAM surface temperatures for 2000 PDT

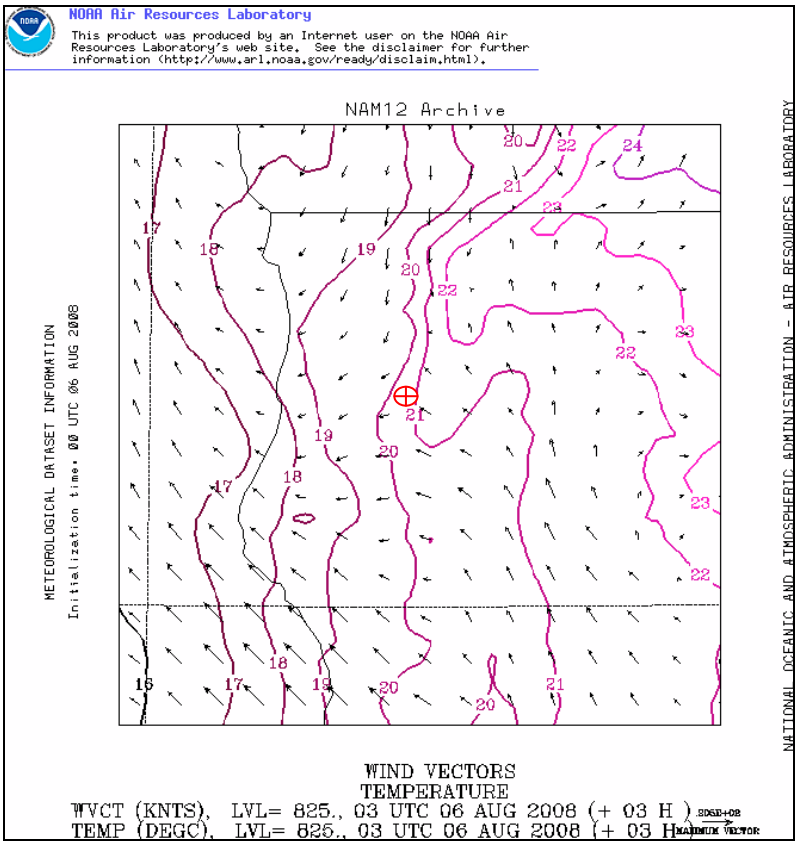


Figure 6 – NAM wind and temperature at 5,800 feet

The NAM model data therefore depicted a temperature between 20° and 23° C, depending on the height and resolution of the terrain considered.

3.0 Satellite Data

The NASA Terra Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery several hours prior to the accident depicted the accident site immediately north of one of the largest and most active fire area (figure 7). The location of the fires also corresponded to the NAM model temperature increase over the central portion of California in the vicinity of the fires. The MODIS image also depicted the smoke from the fires drifting north-northwest above the surface, with no strong low-level winds indicated.

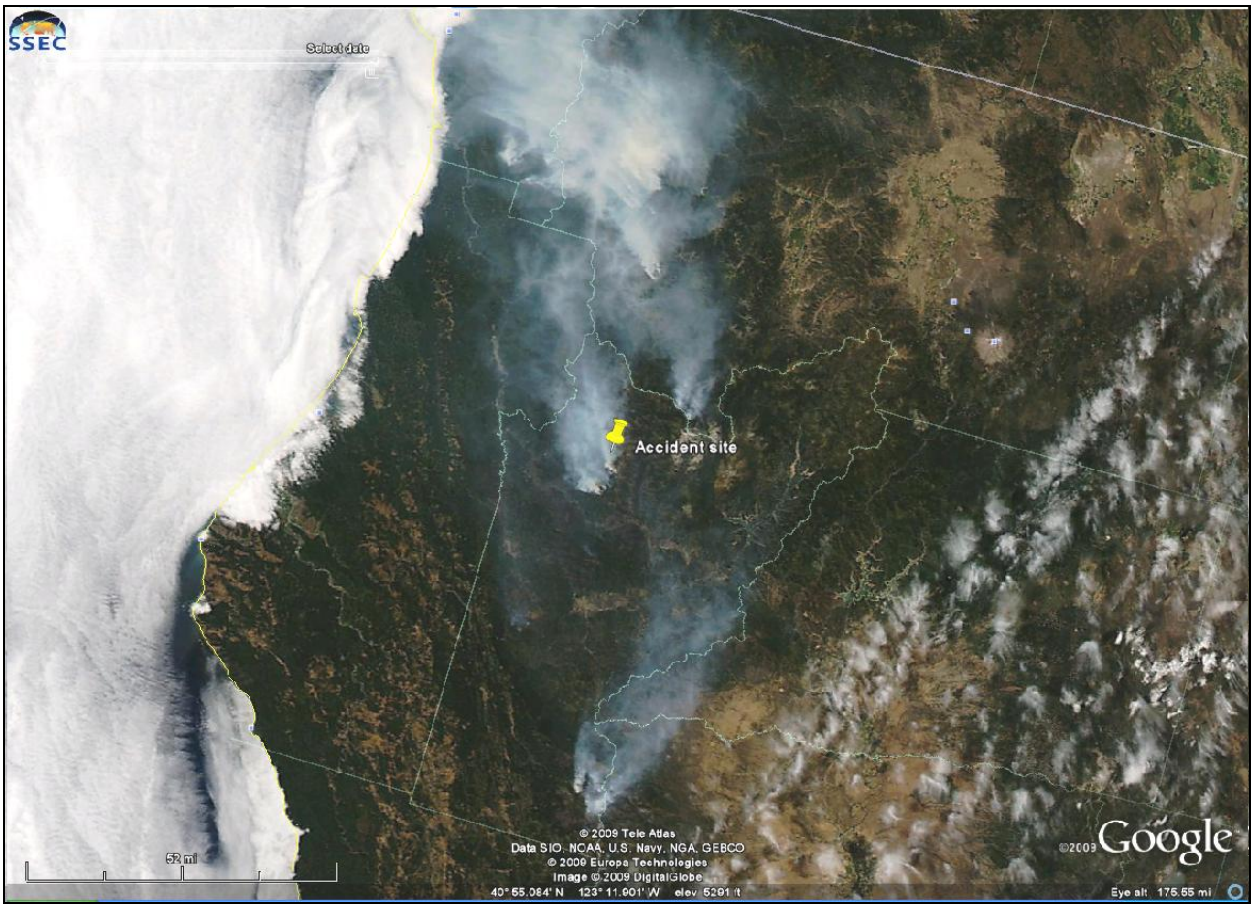


Figure 7 – MODIS image over northern California on the afternoon of August 5, 2008

4.0 Buckhorn Fire

The extent of the Buckhorn fire at 0600 PDT on August 5, 2008, based on the infrared (IR) satellite imagery is included as figure 8, which shows H-44 on the northern edge of the boundary of the fire with the intense infrared heat source located immediately south of the accident location. The closeness of H-44 to the active fire region and the burnt dark ground cover also would be factors in creating warmer temperatures in the vicinity of H-44 than over the Backbone Ridge area to the east.

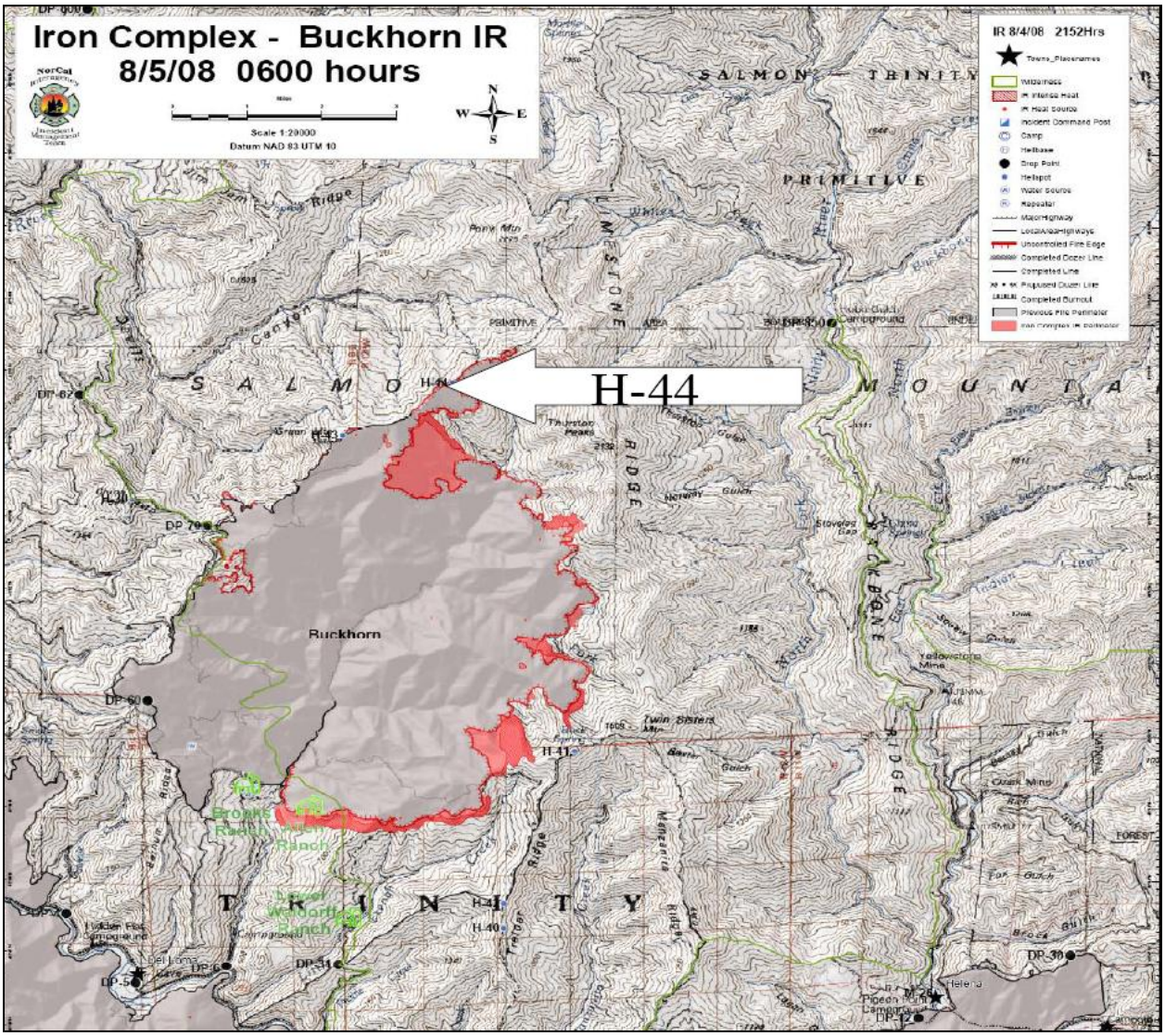


Figure 8 – Buckhorn fire at 0600 PDT on August 5, 2008

5.0 Photograph Evidence

The photograph included in the Meteorological Factual Report was taken by Michael Reid of the United States Forest Service (USFS) who was flying in N420RL enroute to the H44 site to pick up 2 helitack crewmembers. This addendum includes the photographs taken by Mr. Reid at 1945 and 1946 PDT according to Automated Flight Following data as figures 9 and 10 respectively, which were taken approximately 5 and 2 miles west of the accident site looking east, with north to the left and south to the right. The pictures show a nearly vertical smoke plume at low levels. Mr. Reid indicated in his statement that the smoke raised vertically approximately 400 to 500 feet agl, and then bent to the north-northwestward. The smoke plume indicated calm surface winds, with light southerly winds above the boundary level. The mountains in the background are obscured by smoke from the surrounding fires that were burning during the period, but are still identifiable.

Figure 9 – Photograph at 1945 PDT of smoke plume

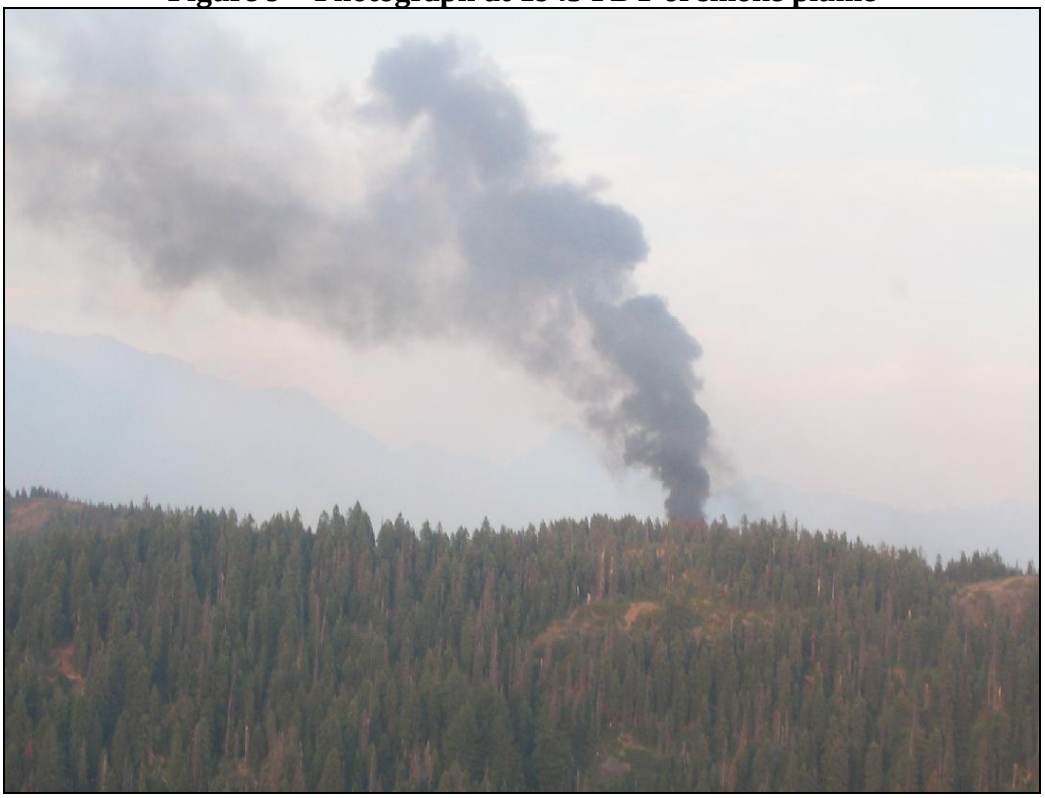


Figure 10 – Smoke plume from accident site 1946 PDT

6.0 Witness Statements

The following additional comments from the witness statements and interviews have been added regarding the weather conditions surrounding the time of the accident.

Matthew Vassel – on arrival to H-44 at 1630 PDT noted northwest winds at 3 to 5 knots, which shifted to the southeast by 1800 PDT, with winds calm at the time of arrival of the S-61.
David Gomez – described the conditions as wind calm, visibility good.
Brian Buchner – indicated light winds out of the southeast.
Ulf Peters – reported light winds, with possible headwind of 0 to 5 mph.
Scott Posner – indicated wind calm.
Alex Rhea – reported wind 3 to 7 mph from the south-southeast
Bill Coultas – copilot indicated winds from the east-southeast at 3 to 5 knots, at the time of lift off from H-44 with a temperature of 22° C.

The cockpit voice recorder (CVR) transcript indicated at 1930 PDT the flight crew contacted the H-44 helipad in bound at 6,000 feet and were provided a report of winds from the south at 3 to 5 knots. As the S-61 was approaching the H-44 landing zone at 1935 PDT the copilot stated the OAT was 20° C[3].

Donald E. Eick
NTSB Senior Meteorologist

[3] The helicopter was estimated operating at 500 to 700 feet above the valley floor. Above the surface, temperature would normally decrease at the dry adiabatic lapse rate of 3° C per 1,000 feet. Therefore, surface temperature at H-44 would be warmer than this reading by 1° to 3° degrees. Instrument error and any temperature lag would also have an impact on the final reading at the surface.