
ACORN FIRE
ANALYSIS

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A C O R N

F I R E

A N A L Y S I S

R. L. Bjornsen

October 1987

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ACKNOWLEGEMENT

I want to express my appreciation to the many people who gave of their time during the interviews. Their contribution was a vital part of the facts on which my investigation was founded.

Alpine County staff were very helpful in handling administrative work, especially Dolph Frisius who did an outstanding job of arranging the many details of my work.

The Forest Service, particularly Stan Fitzgerald, Gary Helsel, John Swanson, and Terry Randolph, gave generously of their time. The records and information they provided were given without constraints and were instrumental in developing my report.

My colleague, Robert Lancaster, gave invaluable assistance as my representative at the Acorn Fire Review Team proceedings, and as a sounding board for my conclusions and recommendations.

Lastly, I want to commend the Alpine County Board of Supervisors for their cooperation and support of my investigation. Their interest in seeking to mitigate future wildfire losses will be of great benefit to all concerned.

EXECUTIVE SUMMARY

The Acorn fire started about 1100 hours on July 29, in the West Fork of Carson River Canyon. It burned easterly, down canyon, pushed by moderately gusty gradient winds (to 25 mph) and strong fire generated wind (to 50 + mph) to consume 6550 acres in 6 hours and destroy 26 homes in the Woodfords, California area.

Fire danger buildup, incomplete intelligence on burning conditions, and lack of full commitment of planned resources contributed to the fire escaping initial attack. Once this happened, the fire took control and burned at will through Crystal Springs, Shinnville, Woodfords, Alpine Village, and Mesa Vista subdivisions destroying homes in the process.

Access, readily available water, and non-fire safe prevention measures contributed to the loss of structures. Mutual aid from Sierra Front Wildfire Cooperators, Alpine County volunteer departments, law enforcement, and federal/state agency suppression forces was exemplary. For the most part the Incident Command System worked satisfactorily, but there were areas that needed improvement.

Alpine County should join the Sierra Front Wildfire Cooperators. It needs to enact ordinances which require fire safe measures for homes/structures at the wildland/urban interface. A fire prevention action plan is needed and community residents should share responi-bility in this endeavor.

The County should join the Forest Service in a study for fire protection of state and private watershed lands. The Incident Command System should be incorporated in the County disaster plan. A fire marshal position should be established to coordinate the volunteer departments with the programs mentioned above.

Protection of state and private watershed lands should continue under the present arrangement with the California Department of Forestry.

INTRODUCTION

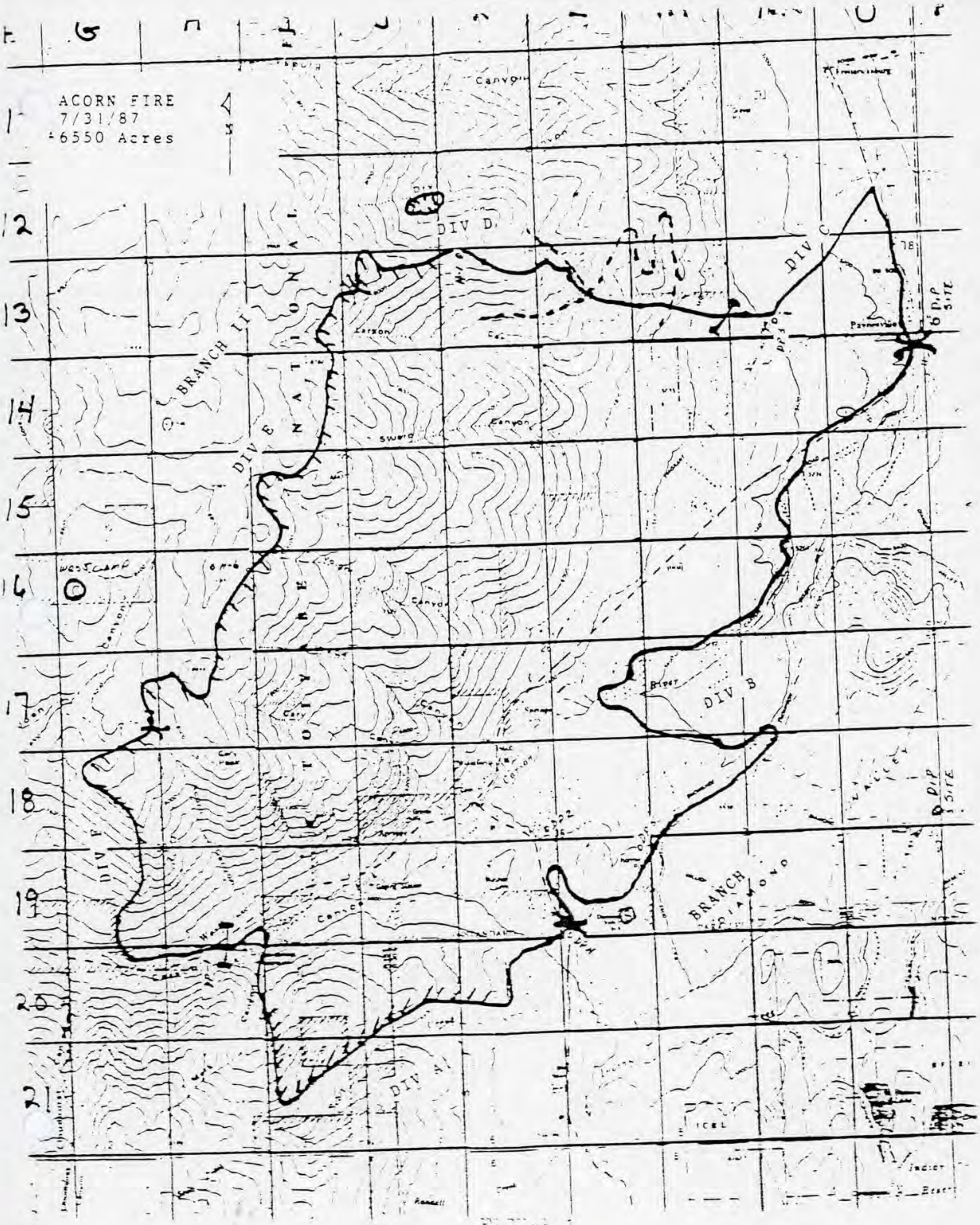
The Acorn Fire started on July 29, and was for all intents and purposes controlled on August 4, 1987, although the Forest Service will not declare it officially out until November 30.

There were 26 homes destroyed, with damage, some of it extensive, to other structures. The fire burned 6,550 acres, of which 56 per cent was National Forest land, and the remainder other ownerships (see Appendix A).

The fire started from an unknown, but probably person-caused, origin approximately 1-1/2 miles up the West Carson River Canyon from Woodfords, California (see Figure 1). The origin site is about 6 chains north of the river on a steep, rocky hillside.

Except for a small area, the fire comsumed most of its acreage during the first burning period, spreading easterly down canyon into the valley under gradient and fire generated wind. Miraculously, there was no loss of life nor serious injury, although property damage was high.

An independent investigation of the fire was performed by the author, from September 25 to October 30, to collect and analyze relevant facts, derive conclusions, and make recommendations to mitigate future occurrence of wildfire damage to residential and commercial property in Alpine County.


ACORN FIRE
7/31/87
±6550 Acres
DIV D
DIV C
DIV B
DIV A
DIV E
DIV F
BRANCH II
BRANCH I
DIP SITE
DIP SITE
FIGURE 1

METHODOLOGY

Literature Review

The body of literature reviewed comprised internal plans, tables, records, memoranda, published and unpublished reports of USDA Forest Service, Bureau of Land Management, California Department of Forestry, and other agencies (see Appendix B).

Interviews

In all, 60 interviews of residents of Alpine County, volunteer fire department members, law enforcement personnel, agency representatives, campers, and other witnesses of the Acorn Fire were conducted (see Appendix C).

Field Validation

Intensive on-site investigation of the burn area was made, including: five trips to the place of origin and its environs; housing areas in Alpine Village, Indian Cemetary Road, Crystal Springs, Mesa Vista, Shinnville and Woodfords; and uninhabited areas of the burn.

An inspection was made of comparable unburned fuel of the same species composition, exposure, soil, and elevation adjacent (west) of the burn.

Engines of the Bureau of Land Management, Forest Service, and Woodfords VFD were checked to determine performance and wildfire suppression equipment capability.

Field offices of BLM, California Department of Forestry, and Forest Service were visited, as was the FS weather station at Markleeville, where weather instrument readings were made to compare with the daily observation of that date.

DESCRIPTION AND CHRONOLOGY

July 19-28. The weather prior to the day of ignition had been exceedingly dry. Little measurable precipitation had been recorded in the area since June 8, when 0.36 inches was measured at the Markleeville station approximately 6 airline miles from the fire's origin. Fire danger rating had been extreme for the previous 5 days; fuel moisture in dead, woody fuels for 0 to 1 inch size class had been 4-8 percent in the preceeding 10-day period. It was 4 percent on the day of ignition. Afternoon wind speeds at Markleeville had been 18-20 mph each day since July 23 (see Appendix D).

July 29. The fire was first observed by a camper at approximately 1055 hours, although not reported until 1130 by a passing motorist at the Woodfords Store. The camper described the fire as a "tiny smoke, with no flames visible".

The fire was located on a south aspect slope averaging 70 per cent, which means it would rise 70 feet vertically for every 100 feet horizontal distance. The ground fuels were duff and litter to a depth of 6-9 inches, with scattered manzanita (Arctostaphylos patula), mountain mahogany (Cercocarpus ledifolius) and chinquapin (Castanopsis sempervirens) growing as an understory beneath a mature Jeffrey pine (Pinus jeffreyi), and white fir (Abies concolor) overstory. There were a few intermingled Jeffrey pine saplings scattered in the fire area. No evidence was found of previous wildfire of any significance since the turn-of-the-century.

The soil mantle is decomposed granite, interspersed with large outcroppings of granite boulders and loose bedrock from cantalope to watermelon size (see Illustrations). Footing everywhere is insecure with constant danger of rolling rock to those working below.

There is an outcropping of large boulders above (north of) the fire origin (see Figure 2) supporting virtually no vegetation but probably contained duff and litter in the crevices.

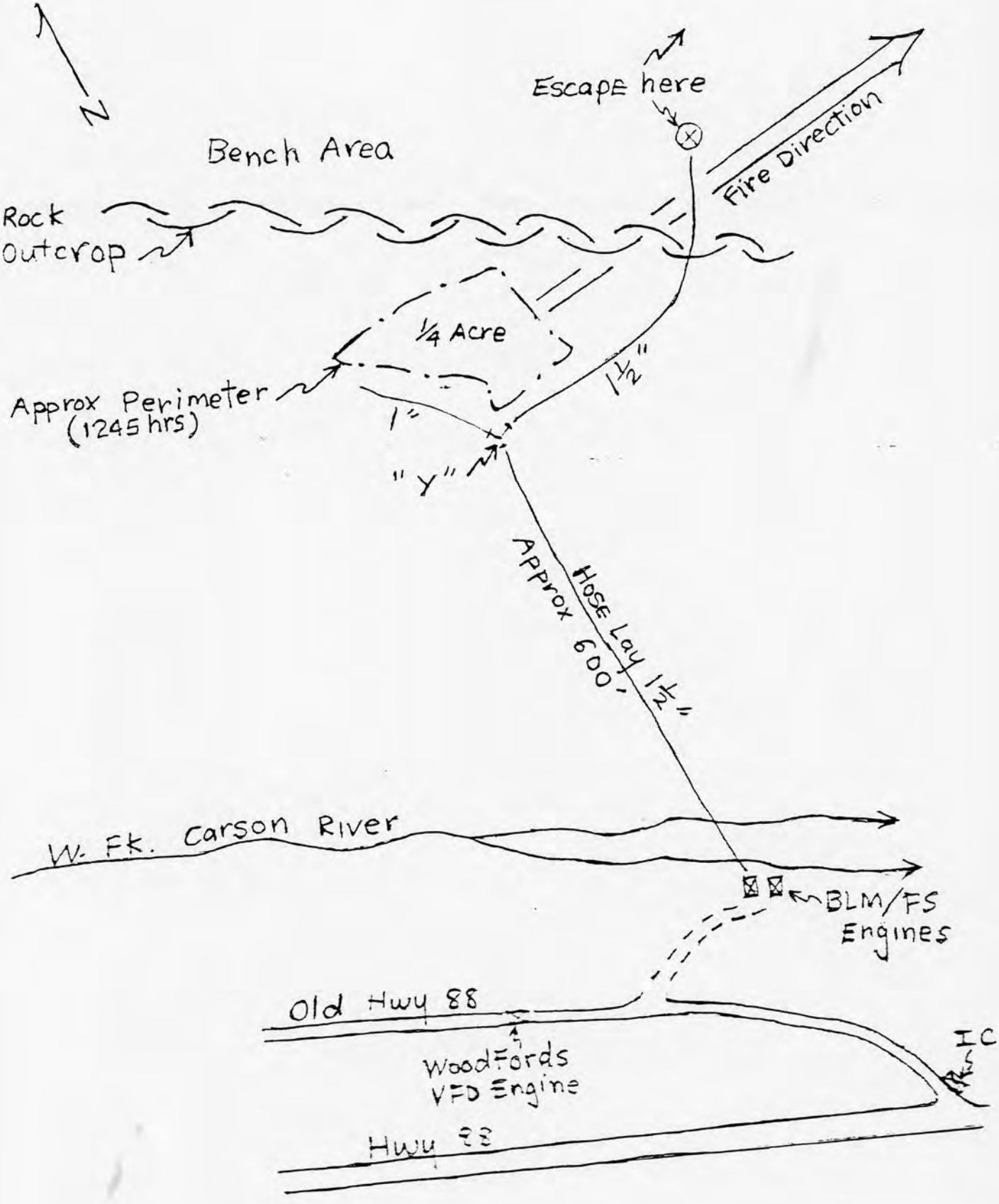
Table I shows a time sequence chronology of succeeding events in the fire's history. Following is a general narrative of these events:

Initial Attack Phase

Forest Service and BLM suppression forces, consisting of two engines (#1-5 and #3943), arrived within 15 minutes after the fire was reported and made preparations to attack the fire with water. A Woodfords Volunteer Fire Department engine had arrived about 10 minutes earlier and was positioned farther up old Highway 88 from the FS/BLM engines which were located on a highwater branch of the river (see Figure 2).

Figure 2

INITIAL ATTACK MAP



(Not to scale)

RLB 10/8-

TABLE I

EVENT CHRONOLOGY

Time 1/	Event
1100	Camper sees fire
1130	Fire reported
1140	Woodfords VFD arrive at old Hwy 88
1200	Hose lay to base of fire (4 persons)
1230	First helicopter bucket drop
1245	Reinforcements arrive on fire (2 persons)
1300	Silver State Hotshot crew arrives on fire
1305	First air tanker drop
1415	Fire escapes initial attack
1424	Third alarm, mutual aid dispatch
1445	Alpine County requests 2 tankers standby
1500	Alpine Village residents notified possible evacuation
1530	Class I team ordered
1600	Residents evacuate Alpine Village, fire moving in
2200	Fire still active in Mesa Vista; south of Crystal Springs

1/ Approximate

A hose lay was made by 4 crew persons from primary pumping engine #1-5 to the base of the fire; this took about 15 minutes. A second engine would later be used to draft water from the river into the primary's tank to sustain a constant supply.

A "Y" valve was intalled at the terminus, and a 1 inch hose connected for suppression of the west flank, and a 1 1/2 inch hose connected for east flank suppression. The crew divided and proceeded to cool down hotspots making direct attack on the fire by digging control line where there was sufficient dirt between the rocks.

Priming difficulty was experienced and there were several periods when water flow stopped. It was not until the hose had been recharged a third time that a constant flow was maintained. Elapsed "down" time when no water was available was estimated at 30 minutes.

Fire behavior at this juncture was characterized as: Slow rate of spread and high resistance to control; flame heights 1-2 feet with complete combustion in dead, woody fuels; advancing in 6-9 inch duff and litter between rocks; flareups of sparse manzanita and mountain mahogany brush; smoke white, rising straight up with slight easterly drift down canyon; wind west, 1-2 mph.

A few minutes into initial attack Engine 1-5 arrived with 2 persons. Except for a pump operator, they proceeded to the fire with additional hose and hand tools. Engine #3943 foreman assumed command of the suppression forces. His strategy was to build line and flank the fire on the east/west perimeters into the large rock outcropping on the north perimeter. He deemed the latter a sufficient barrier to stop the spread under existing conditions. Having accomplished line construction, the firefighters would mopup hot spots to the interior and hold the fire to 1 acre or less.

Later, a helicopter with water dropping bucket and an air tanker would be used to reinforce the line by dropping on hot spots or coating fuels adjacent to the line.

Engine #1-6 with 3 persons arrived about 1230 and were on the fire line at 1245. The foreman of #1-6 was assigned as operations section chief. He immediately scouted the fire to determine tactics. The fire was approximately 1/4 acre in size at that time.

At 1300 hours, the 20 person BLM Silver State hotshot crew arrived at the bottom of the fire and were divided into two squads, with #1 squad of 6 persons building control line from the "Y" anchor point up the west flank, and #2 squad of 12 persons building line along the east flank; each squad being supported by water from the hose lays. The suppression tactic was still direct attack where heat and safety would allow this method.

Meanwhile, starting with the first attack, rolling embers/fuel had caused the fire perimeter to move downhill, necessitating moving hose and rebuilding lost fireline, thereby delaying containment.

While these events were occurring, the helicopter with 100 gallon bucket made several largely ineffective drops on the fire, and the air tanker made 4 drops of retardant which were effective for a short time, but did not materially slow the fire advance (see Figures 3 & 4).

Behavior at this stage showed increased wind velocity with occasional gusts to 15 mph and flame lengths to 6 feet. Squad #1 was able to build line and hold the west flank against a backing fire; squad #2 was experiencing increasing difficulty as they constructed line to the northeast and over the large boulder outcropping. They were successful in traversing the outcropping and were able to build about 1 chain of line on the bench area above before the fire increased intensity and started to outflank them, meanwhile creating a spot fire about 10 chains down canyon (easterly).

The fire had now escaped initial attack, and for tactical, plus safety reasons, the entire suppression force was pulled out of the area. The Hotshots were assigned to an anchor point up river on the north side and ordered to build line on west flank of the fire. The three engine crews were deployed to other locations east of the bridge in the Crystal Springs area.

Escaped Fire Phase

After the fire outflanked the Silver State Hotshots, it began to pick up momentum by making a series of fast runs to the north up the steep canyon walls to the ridge tops. Concurrently, it moved east behind increasing down canyon winds, starting spot fires well in advance of the main fire front.

In some places erratic winds caused the fire to move in a southerly direction. This accounted for a series of spot fires across Highway 88 below the bridge and into the Crystal Springs subdivision. As it moved easterly, over time, the fire developed two heads; one that eventually engulfed the Mesa Vista Subdivision; the other which took out homes in the Crystal Springs, Shinnville, and Alpine Village areas.

The major advance occurred in a matter of 6 hours (1400 to 2200 hours). Eye witness accounts report flame lengths from 60 to 100 feet, fire whirls, houses bursting into flame, fire generated winds of 50 mph, and eye blinding smoke---literally a fire storm of awesome proportions.

During this period, the fire organization progressed from a small fire incident to a large, class I incident command structure; with appropriate support groups. Firefighting resources were increased in like manner until there were scores of engines from many jurisdictions. Tractors, water tenders, air tankers, helicopters and a multitude of other equipment and persons to man them (see Appendix E) were brought into use.

Priority was placed on saving lives and structures. Wildland suppression became secondary except where it could affect/benefit structure protection.

By dawn of July 30, the threat to life and property had largely passed, and suppression effort was directed to containing the fire on its northern, southern and western flanks. On the east flank the fire had run out of fuel in valley land, or against the Fredericksburg burn of the previous year.

ANALYSIS

Weather.

Weather has a profound influence upon combustion of forest fuels in a wildfire. The fuel moisture, which is the water content of a fuel particle expressed as a percent of the ovendry weight of the particle, largely dictates the rapidity with which a fire will ignite and burn since moisture must be reduced sufficiently for combustion to take place (see Figure 5).

Wind is an important factor. It provides oxygen needed for combustion and, as the velocity increases, enhances the combustion process and propagates the fire by increasing radiant heat transfer and by carrying airborne sparks/embers to ignite spot fires in advance of the main fire (see Figure 6).

Relative humidity indirectly affects fire behavior. Air with low humidity absorbs moisture from fuels. Fine fuels can gain or lose moisture quickly in response to relative humidity.

Topography is another factor. The steeper the slope the faster the fire burns (see Figure 7). Another component of topography is aspect, or direction faced. South and west aspects receive more solar radiation, dry out faster, have higher temperatures, and are more conducive to spread of fire.

Relevant components of forecast and observed weather observations for July 28-29 are shown in Tables II & III; complete data can be found in (Appendix F).

Interpretation of these weather records support that fire danger conditions could be, and were, extreme on July 29. Not only was the fuel moisture (4-9%) in the dead/woody fuels from 0 to 3 inch and larger size class nearly bone dry, but the forcast wind (15-25 mph) and dry humidities (5-15%) portended a severely difficult fire suppression situation. This was validated by on-fire weather measurements (taken about 1400) which recorded 12 percent relative humidity and west wind up to 15 mph.

In other words, should a fire occur on July 29, after the day's burning period had started, i.e., the part of each 24-hour period when fires will spread most rapidly, typically from 1000 to sundown, it would require fast, hard hitting initial attack to assure containment within that burning period.

Initial Attack Phase

Dispatching. The Woodfords & Markleeville Mutual Attack Zone, "Automatic Dispatch of Additional Resources" plan (see Appendix G), "1st Alarm, Red Manning Class", was initiated at 1148 by the Carson District Assistant Fire Management Officer (AFMO). This normally activates the following resources with various move-up resources to fill

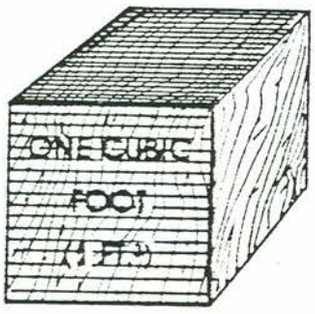
FUEL MOISTURE CONTENT — IS THE QUANTITY OF MOISTURE IN THE FUELS EXPRESSED AS A PERCENT OF THE OVEN DRIED WEIGHT.

Size and shape affects the surface area to volume ratio of fuels. Small fuels and flat fuels have a greater surface-area-to-volume ratio than larger fuels.

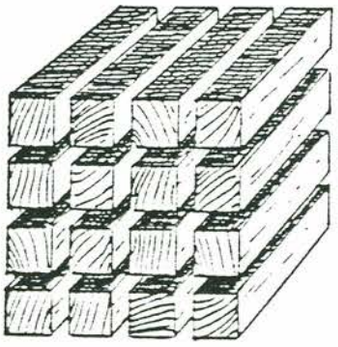
shows the relationship between fuel size and surface area. The cube or block of fuel on the left is one foot on each side and contains one cubic foot. The surface area of this cube is six square feet.

If that same cube is divided up into 16 pieces as shown on the right, we have the same volume of fuel, but now there is much more surface area to the 16 pieces. Calculations will show 18 square feet for the same cubic foot of fuel. This is three times the surface area of the cube on the left.

Why is this important to fire behaviour? We know from our experiences in starting small fires that small fuels ignite and sustain combustion easier than large blocks of fuel. Less heat is required to ignite the small particles.



SURFACE AREA
6 SQ. FT.



SURFACE AREA
18 SQ. FT.

SIZE AND SHAPE AFFECTS THE SURFACE AREA TO VOLUME RATIO OF FUELS. SMALL FUELS AND FLAT FUELS HAVE A GREATER SURFACE AREA TO VOLUME RATIO THAN LARGER FUELS.

FIGURE 6

One of the most important and least predictable influences affecting fire behaviour is <u>wind</u>.

Wind makes fire burn faster by increasing the supply of oxygen and by driving radiant heat into adjacent fuel.

wind encourages combustion and spread of the fire in one direction, but direction can change erratically as the wind shifts.

WIND INCREASES RADIANT HEAT TRANSFER

Wind can carry sparks and firebrands ahead of the main fire starting spot fires. Wind increases evaporation from damp surfaces by carrying away moist air and bringing in dryer air.

The effect of fuel moisture on rate of combustion is what determines its influence on fire behaviour.

When fuel is moist, combustion is slow because part of the heat required for ignition is used to evaporate the moisture. As fuels become dryer, more heat is available to heat the fuel itself.

<u>Relative humidity</u> is an important indirect factor affecting fire behaviour. Dead forest fuels and the surrounding air are always exchanging moisture.

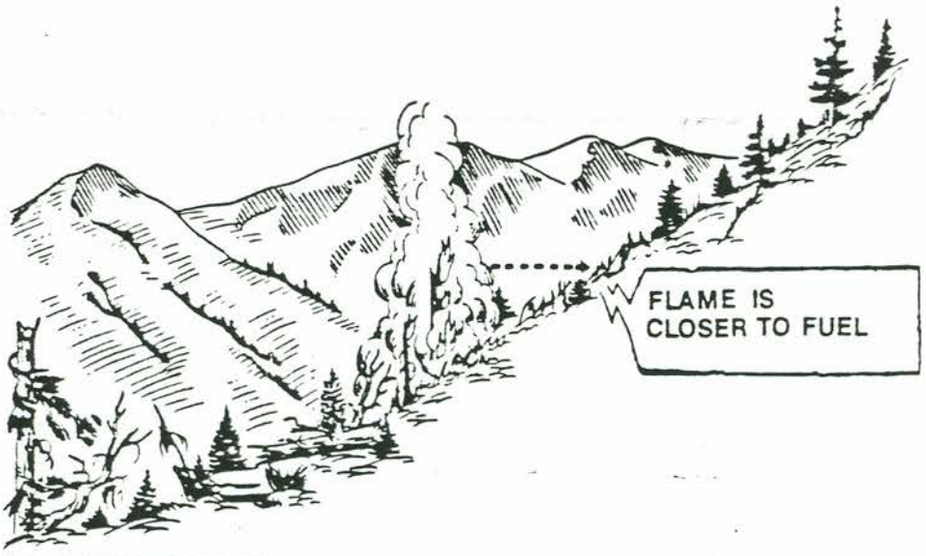
Air with low humidity absorbs moisture from the fuels. Fuels absorb moisture from air with high humidity.

<u>Fuel moisture</u> changes with the humidity. Fine or flashy fuels gain or lose moisture quickly in response to changes in relative humidity. Heavy fuels respond more slowly to humidity changes.

FIGURE 7

Slope is another factor of topography. The steeper the slope the faster the fire burns.

On a slope the unignited fuels above the fire receive radiant and convective heat, and therefore start more quickly. This is one of the reasons that fires usually burn uphill.



STEEP SLOPES INCREASE RADIANT HEAT TRANSFER

The position of the fire, e.g., near the valley bottom or the top of a ridge, is another topographic factor. Fires starting at the base of the slope reach large size because a greater amount of fuel is available.

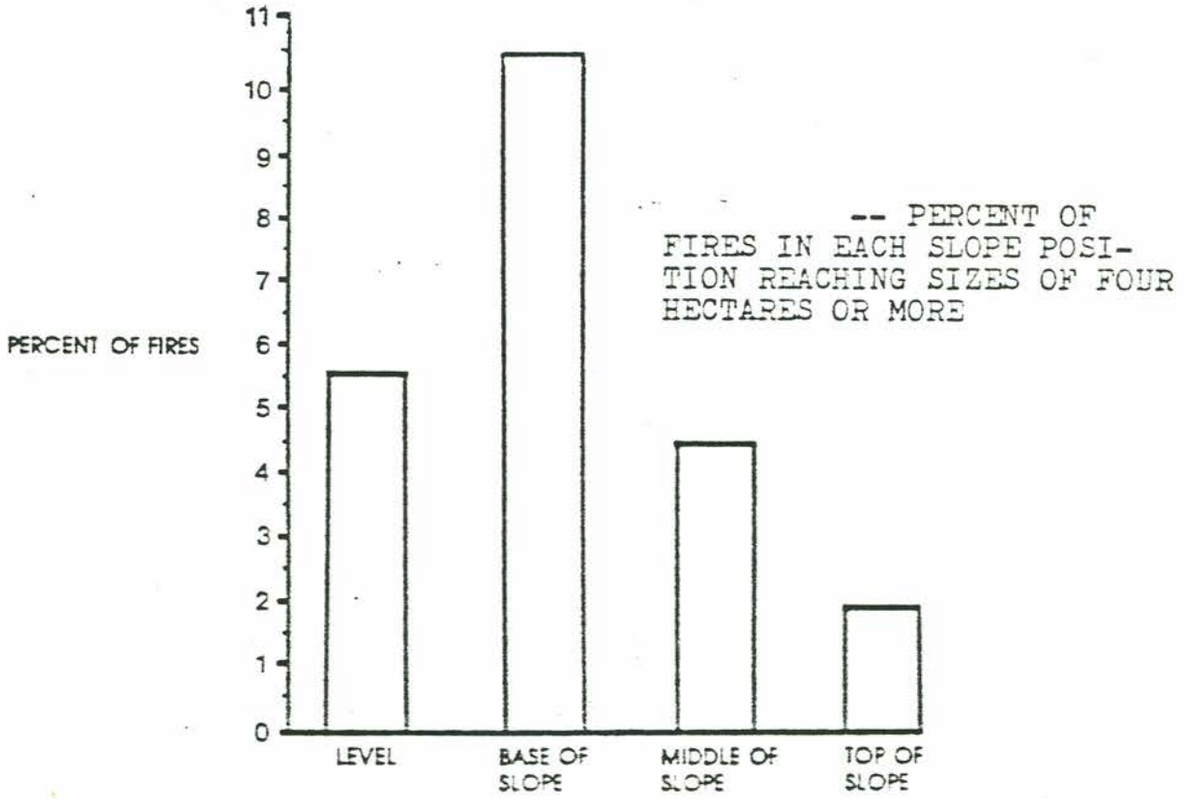


TABLE II

0930 PDT Tuesday, July 28, 1987

FIL05I EXISTING FILE. DO YOU WANT TO OVERWRITE (YES OR NO) :YES

FIL11I TYPE A ^BREAKEY TO EXIT TEXT INPUT
READY FOR INPUT

...EWX
...0 271630
...IONAL WEATHER ...CE RENO NV
FIRE WEATHER FORE... T
930 AM PDT TUE JUL 28 1987

.
WEATHER DISCUSSION...NO FORECAST GUIDANCE BECAUSE OF COMPUTER FAILURES THIS MORNING..HOWEVER SATELLITE PICTURES TELL THE STORY. CONSIDERABLE THUNDERSHOWER ACTIVITY IN NORTHWEST ARIZONA THIS MORNING WHILE CLOUD DEBRIS STRETCHES NORTHWARD INTO EASTERN NEVADA. LIGHTNING DETECTION SHOWS NUMEROUS STRIKES IN THE NORTHWEST ARIZONA STORMS. EXPECT REDEVELOPMENT OF THUNDERSHOWERS IN EASTERN NEVADA THROUGH MIDWEEK WITH LOCALLY HEAVY RAINS POSSIBLE. WESTERN NEVADA AND THE EAST SLOPES CONTINUE DRY IN SOUTHWEST FLOW. SHOULD SEE A GRADUAL SHIFT WESTWARD OF THUNDERSHOWER ACTIVITY WITH POSSIBLE DRY STORMS ALONG THE WEST EDGE OF DEVELOPMENT. HOWEVER...THE EXTREME WEST INCLUDING THE EAST SLOPES SHOULD BE SHIELDED BY THE PERSISTENT SOUTHWEST FLOW ALOFT.
.
----------< ZONE FORECASTS >----------
TODAY...
.
ZONES 570-571-572-451-453-576: MOSTLY SUNNY. A FEW CUMULUS BUILDUPS POSSIBLE ZONE 576.* LAL 1. S-SW WINDS 12-22 MPH RIDGETOPS SURFACING IN THE AFTERNOON. 10,000 FT WINDS...S-SW 15-25 MPH.
.
ZONES 452-454-455-456: PARTLY CLOUDY. SCATTERED AFTERNOON/EVENING THUNDERSHOWERS --MOSTLY WET--. LOCALLY HEAVY RAINS POSSIBLE. LAL 3-4. LIGHT MORNING WINDS. AFTERNOON WINDS VARIABLE TO 15 MPH EXCEPT S-SW 12-22 MPH NORTHWEST PORTION OF ZONE 456. GUSTY ERRATIC WINDS NEAR THUNDERSHOWERS. 10,000 FT WINDS...S-SE 10-15 MPH.
- -
TONIGHT...
.
ZONES 570-571-572-451-453-576: CLEAR. LAL 1. EVENING WINDS DECREASING BY SUNSET. LOW TEMPS 45-55. MAX RH RECOVERY 30-50%.
.
ZONES 452-454-455-456: THUNDERSHOWERS DECREASING BY LATE EVENING WITH A FEW LINGERING RAINSHOWERS OVERNIGHT. LAL 3-4 EVENING HOURS DECREASING TO 1-2. LIGHT WINDS. GOOD HUMIDITY RECOVERY 60-90%.
- -
WEDNESDAY...
.
ZONES 570-571-572: SUNNY. LAL 1. S-SW WINDS 12-22 MPH RIDGETOPS SURFACING THE AFTERNOON. LITTE CHANGE TEMPS/RH WITH HIGHS 80-90. AFTN RH 8-12%. 10,000 FT WINDS...S-SW 15-20 MPH.
.
ZONES 451-453-576: MOSTLY SUNNY IN THE MORNING. A FEW CUMULUS IN THE AFTERNOON WITH A SLIGHT CHANCE OF THUNDERSHOWERS ZONE 576-SOUTHEAST HALF ZONE 453-AND EAST HALF ZONE 451. LAL 1-2. LIGHT MORNING WINDS. AFTERNOON WINDS SW-W 15-25 MPH. LITTLE CHANGE TEMPS/RH WITH HIGHS 85-95. AFTN RH 5-15%. 10,000 FT WINDS...SW 15 MPH.
.
ZONES 452-454-455-456: PARTLY CLOUDY WITH A FEW MORNING SHOWERS. SCATTERED AFTERNOON/EVENING THUNDERSHOWERS --MOSTLY WET--. LIGHT MORNING WINDS. AFTERNOON WINDS VARIABLE 5-15 MPH WITH GUSTY WINDS NEAR THUNDERSHOWERS. COOLER DUE TO CLOUD COVER. AFTN HUMIDITIES 20-40%. 10,000 FT WINDS...S 10-15 MPH.
.* Kamiaeville station = 576

0930 PDT Tuesday, July 28, 1987

----------< EXTENDED FORECASTS >----------

.
3-5 DAY FORECAST FOR THURSDAY THROUGH SATURDAY...PATTERN UNDERGOES VERY LITTLE CHANGE DURING THE PERIOD WITH HIGH PRESSURE OVER THE SOUTHERN PLAINS AND UPPER LOW OFF THE PACIFIC NORTHWEST COAST. THUNDERSHOWERS OVER MOST OF THE DISTRICT WITH A CHANCE IN THE NORTHWEST. CONTINUED WARM WITH LIGHT DAILY WINDS EXCEPT BREEZY IN THE EXTREME NORTHWEST ZONES.

.
6-10 DAY OUTLOOK FOR AUGUST 03-07...HIGH PRESSURE EXTENDED FROM THE PLAINS WEST TO THE 4-CORNERS AREA. WITH THE TROUGH WEAKENING OFF THE PACIFIC NORTHWEST COAST...EXPECT MOSTLY WET THUNDERSHOWERS TO BECOME WIDESPREAD ACROSS THE DISTRICT. CONTINUED WARM WITH LIGHT WINDS.

.
----------< TODAYS 5AM PDT STABILITY AND 10,000 FT WINDS >----------

.

	LIFTED INDEX	K INDEX	10,000 FT WINDS
MEDFORD OREGON	7	16	SSW 25 MPH
WINNEMUCCA	5	-4	CALM
ELY	-1	26	SW 15 MPH
DESERT ROCK/MERCURY	1	27	SSW 15 MPH

.
EKERN
.

NO FIRE WEATHER FORECAST 0930 PDT WEDNESDAY JULY 29, 1987 NWS RNO

WEATHER DISCUSSION: THE DISTRICT REMAINS UNDER THE INFLUENCE OF TWO WEATHER SYSTEMS. THE UPPER LEVEL TROUGH OVER THE PACIFIC NORTHWEST CONTINUES TO BRING A DRY SOUTHWEST FLOW TO THE SIERRA ZONES AND NORTHWEST NEVADA, WHILE HIGH PRESSURE TO THE SOUTHEAST PUMPS MOISTURE FOR AFTERNOON AND EVENING THUNDERSTORMS OVER THE REMAINDER OF THE DISTRICT. LITTLE CHANGE IN THIS PATTERN IS SEEN FOR THE NEXT FEW DAYS, BUT THE LONG RANGE FORECAST CHARTS CONTINUE TO INDICATE THAT THE TROUGH WILL EVENTUALLY WEAKEN, ALLOWING THE HIGH PRESSURE TO PUSH THE THUNDERSTORM ACTIVITY FURTHER WEST AND NORTH.

---------- FORECASTS ----------

TODAY...
ZONES 570, 571, 572 NORTHWEST HALF 453, AND 451: SUNNY. LAL 1. WINDS SOUTH TO WEST AT 10-20 MPH IN THE AFTERNOON

ZONES 576, WEST HALF 454, NORTHWEST PORTION 456, AND REMAINDER 453: MOSTLY SUNNY, WITH ISOLATED AFTERNOON AND EVENING THUNDERSTORMS. LAL 2. AFTERNOON WINDS SOUTHWEST TO WEST AT 5-15 MPH.

ZONES 452, 455, AND REMAINDER OF ZONES 454 AND 456: BECOMING PARTLY CLOUDY WITH SCATTERED AFTERNOON AND EVENING THUNDERSTORMS- LAL 2-3. WINDS SOUTH TO WEST AT 5-15 MPH.

TONIGHT...
ZONES 570, 571, 572, 576, 451, 453, 454: CLEAR. LAL 1. WINDS VARIABLE AT GENERALLY LESS THAN 10 MPH, EXCEPT 15-25 MPH PEAKS AND RIDGES SIERRA ZONES. LOWS 45 TO 55. MAX HUM RECOVERY 40-70 PERCENT

ZONES 452, 455 AND 456: PARTLY CLOUDY WITH MOST THUNDERSTORMS ENDING AFTER DARK, BUT WITH A FEW CONTINUING UNTIL MID-NIGHT - LAL 1-2. LOWS 47 TO 57, EXCEPT NEAR 75 SOUTHERN DESERTS. MAX HUM RECOVERY RANGING FROM 50-80 PERCENT NORTH, TO NEAR 30 PERCENT SOUTHERN DESERTS.

THURSDAY...
NO CHANGE FROM TODAYS FORECAST .... SEE FORECAST FOR TODAY ABOVE....

OUTLOOK FOR FRIDAY...
NO SIGNIFICANT CHANGE....

3-5 DAY OUTLOOK FOR SATURDAY THROUGH MONDAY... LITTLE CHANGE THROUGH THE PERIOD, EXCEPT FOR AN INCREASING CHANCE OF THE AFTERNOON THUNDERSTORMS SPREADING INTO WESTERN AND NORTHWEST NEVADA BY MONDAY.

6-10 DAY OUTLOOK... FOR TUESDAY THROUGH FRIDAY... WARMING TREND WITH SCATTERED MAINLY AFTERNOON AND EVENING THUNDERSTORMS OVER THE DISTRICT. NORMAL DAILY WINDS.

	INDEXES			
	LIFTED INDEX	K INDEX	10,000 FT. WINDS	PRECIP. WATER
WINNEMUCCA	5	-1	NW 5	.40
ELY	-3	30	SW 15	.73
DRA	2	26	S 10	.68

...DAVID CARMAN

1430 PDT, Wednesday, July 29, 1987

RENO FIRE WEATHER FORECAST 1430 PDT WEDNESDAY JULY 29, 1987 NWS RENO

WEATHER DISCUSSION: LITTLE CHANGE IS SEEN THROUGH THE WEEKEND, WITH A DRY SOUTHWEST FLOW OVER THE SIERRA ZONES AND WESTERN NEVADA, AND A MOIST SOUTHERLY, THUNDERSTORM PRONE, FLOW OVER EASTERN NEVADA. EVENTUALLY IT LOOKS LIKE THE THUNDERSTORMS WILL SHIFT TO THE WEST AND NORTH, BUT IN THE MEANTIME EACH DAY LOOKS TO BE A CARBON COPY OF THE PREVIOUS DAY.

---------- FORECAST ----------

TONIGHT...
ZONES 570, 571, 572, 576, 451, 453, 454: CLEAR. LAL 1. WINDS BECOMING DOWNSLOPE GENERALLY LESS THAN 10 MPH, EXCEPT 15-25 MPH PEAKS AND RIDGES. LOWS 45 TO 55. MAX. HUM. RECOVERY 40-70 PERCENT.

ZONES 452, 455: PARTLY CLOUDY, BUT CLEARING THROUGH THE NIGHT. MOST THUNDERSTORMS ENDING AFTER DARK, BUT CHANCE OF A FEW CONTINUING UNTIL)NIGHT - LAL 1-2. LOWS 47 TO 55. MAX HUM RECOVERY 50-80 PERCENT.

ZONE 456: CLEAR. LAL 1. WINDS VARIABLE LESS THAN 10 MPH. LOWS RANGING FROM NEAR 50 DEGREES NORTH TO 75 SOUTH. MAX HUM RECOVERY RANGING FROM 50-70 PERCENT NORTH TO NEAR 30 PERCENT SOUTH.

THURSDAY...
ZONE 570, 571, 572, 576, 451, 453: SUNNY. LITTLE CHANGE TEMPERATURES AND HUMIDITIES. LAL 1. WINDS SOUTH TO WEST AT 5-15 MPH, AND UP TO 20 MPH IN THE NORMALLY WINDIER LOCATIONS.

ZONES 452 AND 455: MOSTLY SUNNY IN THE MORNING, BECOMING PARTLY CLOUDY IN THE AFTERNOON WITH WIDELY SCATTERED AFTERNOON AND EVENING THUNDERSTORMS- LAL 2-3. LITTLE CHANGE TEMPERATURES AND HUMIDITIES. WINDS SOUTHWEST TO WEST AT 5-15 MPH, EXCEPT STRONGER NEAR THE THUNDERSTORMS.

ZONES 454 AND 456: MOSTLY SUNNY WITH ISOLATED AFTERNOON AND EVENING THUNDERSTORMS - LAL 2. LITTLE CHANGE TEMPERATURES AND HUMIDITIES. WINDS SOUTH TO WEST AT 5-15 MPH, WITH LOCAL GUSTS TO 20 MPH.

OUTLOOK FRIDAY: NO SIGNIFICANT CHANGE FROM THURSDAY...

3-5 DAY OUTLOOK FOR SATURDAY THROUGH MONDAY: LITTLE CHANGE THROUGH THE PERIOD, EXCEPT FOR A CHANCE OF THUNDERSTORMS SPREADING FURTHER WEST AND NORTH BY MONDAY.

)10 DAY OUTLOOK TUESDAY THROUGH FRIDAY: WARMING TO ABOVE NORMAL TEMPERATURES WITH AFTERNOON AND EVENING THUNDERSTORMS LIKELY MOST ZONES.

...DAVID CARMAN
#

1430 PDT Wednesday, July 29, 1987

++++++++++++++ TOMORROWS FORECAST OF NFDRS INDICES ++++++++++++++++++

----------07/29/87--FCST--22:12GMT----------

STAT'N	DY	HR	W	DBT	DPT	RH	AL	TL	DIR	WS	10	TMX	TMN	HMX	HMN	P1	P2
WMC	30	13	1	92	27	10	1	1		10	3	95	52	30	10	0	0
EKO	30	13	1	86	46	25	2	2		7	6	89	54	67	20	0	0
HOLLOW	30	13	1	88	36	16	2	2		9	6	88	59	52	16	0	0
SPRUCE	30	13	1	80	41	25	2	2		13	10	84	54	88	25	0	0
REDPT	30	13	1	85	39	20	2	2		10	7	85	54	71	20	0	0
PINECR	30	13	1	89	39	17	2	2		7	6	89	58	48	17	0	0
DOG	30	13	0	81	34	19	1	1		8	4	84	56	40	15	0	0
BOWERS	30	13	0	85	32	15	1	1		10	4	87	48	53	15	0	0
ANDERS	30	13	0	88	32	13	1	1		4	6	91	46	63	13	0	0
GALENA	30	13	0	81	37	21	1	1		15	3	81	48	63	20	0	0
CLRCK	30	13	0	80	32	18	1	1		14	4	83	59	39	15	0	0
AUSTIN	30	13	2	84	34	17	2	2		6	7	88	58	40	16	0	0
TPHFS	30	13	1	89	40	18	1	1		12	5	89	55	64	18	0	0
ELY	30	13	3	83	49	30	3	3		14	8	83	48	93	29	1	0
KYLE	30	13	2	80	23	12	2	2		12	7	82	51	33	11	0	0
CEDERV	30	13	1	87	19	8	1	1		7	4	87	52	27	8	0	0
OBSVN	30	13	1	68	26	20	1	1		21	6	68	52	36	20	0	0
LAUFMN	30	13	1	85	21	9	1	1		7	3	85	51	30	9	0	0
SUSANV	30	13	1	85	33	15	1	1		8	6	88	48	55	14	0	0
RAVDLE	30	13	1	81	29	15	1	1		13	5	84	40	64	14	0	0
MARKVL	30	13	1	80	38	22	1	1		17	4	84	52	54	18	0	0
BRDGPT	30	13	1	83	36	19	1	1		10	4	83	36	100	18	0	0
WALK	30	13	1	87	21	9	1	1		10	2	90	58	25	8	0	0

SYNOSI END-OF-FILE ENCOUNTERED

in behind those dispatched:

- Two patrols
- Seven engines
- Two water tenders
- Two Handcrews (NDF)
- Two helicopters
- One air attack aircraft

In addition, a request can be made for Markleeville/Woodfords VFD's if structures are threatened.

The AFMO 1/ went west up canyon but failed to see the fire, whereupon he informed the dispatcher to stop the dispatch with exception of two engines which were to continue into the area. Upon viewing the fire from a vantage point at the lower junction of old highway 88 and the present highway, he again modified the dispatch to add one more engine, a helicopter, one hand crew, and a lead plane.

Meanwhile, the Woodfords VFD engine had been dispatched through the Alpine County system and had proceeded to the fire.

Sizeup & First Phase Attack. When initial attack forces, comprised of engines #3943 and #1-5 arrived at 1132, the engine foreman made a decision to make a hose lay to the fire since it appeared from the river vantage point that not much dirt was available for a "dry", direct attack.

Problems were experienced in maintaining pump prime, and it was not until a third recharge had been done (approximately 1245) that a constant flow was maintained; the first and second charges having lasted only a few minutes each.

Volunteer Fire Department. Concurrent with the above attack, the Woodfords VFD brush engine (which was the first to arrive on scene) was stationed on old hwy. 88 some distance above the lower junction where the 3-person crew could view the fire. They continued to view the fire for about the next hour, whereupon they were secured by agreement between the incident commander and the assistant sheriff, who was also assistant VFD chief. During this time they were not called on to assist with initial attack. The IC apparently was unaware of their presence until shortly before their release.

The Woodfords' VFD had received no formal training in wildfire suppression, but had viewed some video tapes on the subject and members had received some on-the-job experience in initial attack on wildfires over the years. They were not equipped with nomex fire resistant clothing, nor other items considered essential to initial attack on wildfires, however, they did have the normal structural turnout coats, pants, and boots.

1/Henceforth called the incident commander (IC)

Their engine was equipped with line building hand tools, but it is doubtful their old model pump had sufficient vertical lift capability to adequately support the hose lay employed on the initial attack here. They did not have sufficient hose to reach the bottom of the fire.

Observer Accounts. During the first hour of attack, law enforcement personnel, local residents, and numerous passersby stopped at vantage points to observe the fire. These people later described the fire behavior and provided a few photos (see Illustrations).

During my interviews a consistent remark was made the fire did not seem to be doing much (advancing) in the early stage, appeared easy to control, and they thought the firefighters were not aggressive enough in their attack.

These observations are not unexpected given the fire behavior and the oblique view of fuel and ground conditions from 1/4 mile away (see Figures 8 & 9). Figures 10 & 11 show the density of rock outcroppings and smaller boulders now bared by the fire, but which would have been obscured by vegetation, smoke, and distance.

The occasional flareup of brush and the lazy drift of smoke tended to disguise the high resistance to control (see Figure 10). Albeit the fire was moving slowly, burning fuel occasionally rolled downhill across the control line causing new line to be constructed and hose to be moved. The flareups generated sparks/brands which in turn ignited more fuel in the super dry fuel bed. Combustion was so complete that little smoke was generated.

Not seeing the firefighters, obscuration by trees/vegetation/smoke aside, was to be expected since there were no more than 6 (until the Silver State Hotshots arrived about 1315) and these were engaged with the hose lay or intermittent line building during the downtimes when no water was available.

Fireline construction often is a slow, methodical process especially when one is working on a steep slope (see figure 11) with uncertain footing and with difficulty in maintaining balance. Typically a lay person would be deceived into thinking the "action was too slow" and there ought to be more evidence of firefighters flailing arms and elbows.

Second Phase Attack. The IC did not go on the fireline during the initial attack or subsequently after the fire escaped. His rationale was that he could view the fire adequately and did not want to bother the firefighters. He had a handi-talkie (portable radio) with 14 channels (frequencies) including airnet for control of air operations.

Communication with the initial attack foreman was unsatisfactory from the start due to a malfunction of the latter's radio. He could, however, talk to a FS crewman who had a handi-talkie. Clear communications with the crew boss was not established for 1-1/4 hours (1245), or until the operations section chief (on-scene fire boss) arrived on the fire.

From the time the hotshot crew arrived on the fire (1300), fire behavior, rather than suppression forces, began to dictate the tactics, leaving virtually no option but to continue building fireline on the east/west flanks which the earlier crew had started. The goal would be to use the north, large rock outcrop as a natural barrier to stop the fire's uphill advance, while containing its lateral spread up/down canyon and trying to hold their line against expected afternoon winds (see Figures 14 - 17).

Perhaps this strategy would have worked had the earlier attack confined the fire to a smaller area, allowing more time for hot spot suppression by the Silver State Crew, and for reduced spotting occurrence which later became a reality (see Figures 18 - 21).

The focus then zeros in on whether there was sufficient sensitivity to the fire's potential for escape, given the existing and predicted weather parameters, fuel dryness, and topography. It accentuates the need for vital on-the-ground intelligence to evaluate the potential and to modify suppression tactics if such were required (see Figures 22 & 23).

The outcome, without the suggested sensitivity/intelligence awareness, could have been the same, i.e., a fire that escaped initial attack---we will never know.

On the other hand, on-fireline knowledge by the initial attack IC could have exposed the vulnerability of the large ridge outcrop as a barrier to the uphill advance of the fire; could have influenced his earlier decision to deactivate 4 engines from automatic dispatch, and perhaps, started them rolling to the fire, or influenced other resource flow such as the two NDF crews and heavy air tankers which were within a one hour estimated arrival time at the fire.

From the start of the fire, time was of the essence; minutes counted if it were to be contained in initial attack. This rationale is supported not by 20-20 hindsight, but by the extreme fire danger conditions that had prevailed for 5 days prior to ignition (see Appendix D); by the up-canyon position of the fire; by its relative inaccessibility to other than ground crew tactics supported by aerial delivered suppressant/retardant.

Escaped Fire Phase

Backfire. After the fire escaped initial attack it moved with such rapidity that the mobilized suppression forces on hand were unable to stop its advance. As it approached the area near the upper Crystal Springs Road, north of its junction with highway 88, it became apparent a backfiring tactic was required if there was to be any chance it could be held at the highway; it was a long shot at best.

This was ordered and executed by agency personnel without success, primarily because the main fire began to spot across the highway south into Crystal Springs area before the backfire had progressed 5 chains along the highway from its point of ignition.

The intended strategy was for the backfire to move into the main fire as it went east toward Woodfords and turn it north up the ridge. In my opinion the probability of success was low because this head of the fire had already generated enough momentum to spot beyond the backfire and continue its course to the east (see Figures 24 & 25).

The term **backfire** was used frequently by Alpine County residents, witnesses and others who observed firing operations. Actually, the backfire tactic was only used a few times. Most of the firing done was **burning out.** Technically, there is a significant difference between the two tactics:

A backfire is employed when behavior conditions are such that a fire must be set a considerable distance (generally more than two chains) from the main fire to consume intervening fuels and allow suppressions forces to hold control lines (or other barriers such as a road). Ideally, the firing is timed to use the main fire as a draft to pull the flames away from control lines.

Burning out is also done from control lines, or barriers, but typically the distance to the main fire is much shorter; less than two chains. Again the purpose is to consume intervening fuels to establish a "black line", thereby strengthening the control line. Two examples of burning out were those performed at Mabel Love's house, and behind the Woodfords Inn.

It should be emphasized, the distances stated between the firing point and the main fire are not fixed. They are only given as a frame of reference; fuels, weather, topography, available forces, strategy, all affect where and when firing will be conducted. Generally, burning out is a routinely used tactic to strengthen control lines, where backfiring is infrequently used except under special circumstances.

Structure Protection.

Saving lives and property became highest priority of suppression forces when it was apparent the fire would move into Woodfords and environs. Available engines were moved to protect structures as the

fire moved eastward. Law enforcement personnel did an admirable job of directing evacuation since no lives were lost in spite of extreme fire behavior conditions.

The incident commander contacted Woodfords VFD in person and informed him to take tactical charge of the Crystal Springs residential area. This order was substantiated by the Toiyabe NF fire management officer who was present at the time.

Subsequently, available agency, and later mutual aid, engines were assigned to protect structures under command of the Woodfords' chief. He continued to direct operations in the Crystal Springs area; later moving to Alpine Village, Shinnville, and Indian Cemetary Road as the fire progressed in these areas.

As mentioned, structual protection was a paramount strategy. Mounting an organized attack to save houses was difficult at best due to the fast moving, erratic fire behavior. Of necessity, engines were forced to "free lance" because they were isolated by fire and smoke, or lacked coherent tactical employment by fireground commanders. This is not to say strike teams were not given orders; in most cases they were, but often it was not possible for higher echelon commanders to maintain a positive span of control due to a fast moving, fluid situation.

Policy. Forest Service and BLM have been criticized for refusal to assist in structural protection on the fire; there may have been isolated instances of this, mainly because agency personnel are not trained nor equipped for this type of firefighting, but on the whole I found their efforts met or exceeded their agency policy which authorizes their forces to protect structures within certain limits (see Appendix H). Figures 26 - 28 show an example of FS personnel fighting structure fires.

There were undocumented cases where people became frustrated with lack of initiative by agency personnel to fight structure fires. In one such case a bystander asked a group of agency engines to take action on some threatened houses; they were out of water but were severely criticized before they could explain the situation; a fact that was never told in the media coverage.

Prevention. Each spring the Forest Service has made fire prevention inspections in the Markleeville-Woodfords area. Measures to improve fire safety were discussed with homeowners and compliance to correct deficiencies to be noted on a pre-addressed **Fire Hazard Abatement Check List** (see Appendix I). Compliance for 1987 inspections is shown in Appendix J, including a Fire Hazard Abatement Program Task Force (June 1987) targeted for the Markleeville/Woodfords communities (see Appendix K).

In addition, home owners were provided literature describing fire safe measures for homes in forest settings. An especially good publication is **Wildfire Protection, A Guide for Homeowners and Developers,**

published by Sierra Front Wildfire Cooperators.

Results. Some homes were lost in spite of full compliance with fire safe prevention measures; probably due to unpredictable/capricious fire behavior, or proximity to severe heat radiation from adjacent structures and wildland fuels.

Many homes that were lost had wood shingle/shake roofs which are notorius for susceptibility to burning brands and for propagating fire to other structures. Other homes were lost because of pine needles on their roofs and flamable vegetation too close to the structure. Firewood stored against outside walls or in close proximity was a frequent contributor to losing the home. One homeowner attributed the saving of her home to moving her wood pile as recommended by the spring prevention inspection.

Mutual Aid

Cooperation in supplying resources from the Sierra Front Wildfire Cooperators and supporting jurisdictions was exemplary. Over 100 engines and accompanying personnel were mobilized. These, along with supporting units, e.g., water tenders, tractors, aircraft, law enforcement units, etc., were readily made available to deal with the incident. Without question, this support was instrumental in mitigating further loss to property than occurred in the early stages of the fire.

Initial request for mutual aid was made through Forest Service channels at 1424. This activated a third alarm under the Toiyabe NF Dispatch System plan to provide a total of 38 engines (including engines already ordered or on hand) from agency and mutual aid sources. Twenty-five of the engines were large, structual firefighting units.

About 20 minutes later Alpine County (presumably the Woodfords VFD Chief), according to the East Fork Fire District log, requested 2 "tankers" to standby in the Crystal Springs area (see Appendix L).

The latter did not constitute an areawide request for mutual aid as has been stated. Alpine County is not a member of the Sierra Front Wildfire Cooperators 1/ and would not be able to activate large scale mutual aid outside regular channels.

Sierra Front Initiative calls for a formal system of activation by member agencies, to be requested and coordinated by the agency in charge of the incident; in this case the Forest Service. Non-members would not have made pre-incident arrangement to pay all mutual aid costs after the first 24-hour commitment of resources.

1/Forest Service, BLM, N. Lake Tahoe Prot. Dist., Tahoe/Douglas Fire Dist., Nevada Div. Forestry, Carson City FD, Douglas Co. FD, Truckee Mdws. FPD, and 4 other agencies not involved in the incident.

Benefit. As was amply demonstrated in the Acorn fire, there is a high payoff from mobilizing and using mutual aid resources. Without them Alpine County residents would have suffered much greater loss in property and perhaps in human life.

The Sierra Front Initiative has been recognized by the National Fire Protection Association as one of two outstanding examples nationwide of mutual aid cooperation in protecting lives and property at the wildland/urban interface.

Interface Problem

Present. While the Acorn fire may have created somewhat of a fire safe environment in the Woodfords' area, this will be of temporary nature. In a matter of a few years the low vegetation will return, especially in the Mesa Vista subdivision. When this occurs a ground fire can develop in the litter and brush which would have potential to carry flames and brands into the structures. There is always the possibility of creating sufficient heat/radiation to put fire into the tree crowns, generating a devastating crown fire.

The Markleeville/Grover Hot Springs area is as vulnerable as Woodfords was pre-Acorn episode; perhaps more so with the heavy influx of summer tourists and the constant threat of person caused fires. Elsewhere in the County, wherever homes are located in a forest/brush environment, there is a threat from wildfire.

Future. Alpine County has the attributes of a much sought after living environment in today's culture---clear air, uncrowded forest landscape. In spite of its remoteness (to Californians) it will continue to experience growth as a desirable living space for permanent residents and summer home occupants alike. In turn, this will accentuate the problem of fire protection at the wildland/urban interface.

An added burden will be placed on wildland and structual protection agencies; in this case, the Forest Service and other federal agencies which occupy 92 percent of the County land and the VFD's having structural protection responsibility in their jurisdictions.

Presently, through a cooperative agreement with the California Department of Forestry, the Forest Service has wildfire responsibility on State and private watershed lands within the County. Whether this arrangement will continue would depend on: Statewide wildland protection balance between CDF and FS, and which agency could best serve wildfire protection requirements of Alpine County.

CONCLUSIONS

General

In arriving at my conclusions I have made a comparison between recorded events, subsequent action, and accepted forest fire control practices in the mountain west.

A determined effort was made to avoid a "20-20 hindsight" approach. Obviously, knowing the outcome of the Acorn fire, there is a temptation to derive conclusions based on what happened. On the other hand, if one evaluates the facts, and bases his conclusions upon what is the accepted norm in forest fire suppression, policy, direction, strategy and tactics, then the result should be sound in principle.

My methodology was to interview as many people as could contribute salient facts about the fire. Time constraints did not permit interviewing every possible source of information; in some cases potential interviewees contribution would have been redundant, or not relevant to the information required. At any event, over 60 people were interviewed during a one-month period; some persons several times. In addition, I made a physical inspection of the burn on numerous occasions, including 5 trips to the origin site.

Emphasis was placed on the initial attack phase since it was key to later events, i.e., escape and a subsequent large fire development. Detail analysis of the latter phase was confined to events which could have had bearing on the actions taken during that phase and their contribution to conclusions/recommendations.

Specific

1). **Not enough attention was given to fire danger conditions existing on the day the fire started.** The fire danger was extreme and had been for the previous 5 days (see "MARKVL T2P2" Appendix D). There had been no measurable precipitation of consequence recorded at the Markleeville weather station in the previous 50 days (see Appendix M). Fuel moisture was extremely low (4-9%) in typical woody, dead fuels from 0 to 3 inch and larger, and had been for the previous 5 days. Afternoon winds were forcasted for 15-25 mph and relative humidity in the 5-15% range.

Any fire ignited on the lower, south facing slope of West Carson River Canyon, on a hot July day would be destined to be difficult to suppress, and should require full resource commitment, including hard hitting initial attack.

2). **The initial attack incident commander should have positioned himself <u>on the fire</u>.** The magnitude of the fire weather buildup made it imperative that accurate intelligence of fuels, burning conditions, resistance to control, and potential of the fire be assessed. As has been pointed out earlier, the real character of the fire could not be

seen from vantage points on the old and new highways.

Such things as complete combustion of fuels with little smoke; 6-9" deep duff and litter on the ground and between the rocks offering a pathway to clumps of brush; nearly instantaneous ignition of dead fuels; 70 percent slope (average); high resistance to control because of little dirt for fireline construction; high ambient temperature (80 degrees+) lack of direct communication with the senior engine foreman on the fire were all harbingers of difficulty to contain the fire before afternoon winds developed.

Observation of the fire from various vantage points engendered too much complacency about the ease with which it could be contained. This would have been dispelled by any experienced fireman upon arrival on fire. The senior engine foreman was worried about it from time he arrived at the lower edge, and continued to be uneasy throughout the early stages of the initial attack. He did not convey his concerns because of radio malfunction. He and his crew worked hard, as did the Silver State hotshot crew later, but were not able to "get ahead" to achieve containment.

While there was a direct communication problem with East Lake Dispatch Center, this had been alleviated by stationing a non-fire employee as relay (with mobile radio) at the mouth of the Canyon. At any event, other relay options could have been employed prior to the above arrangement. It was not essential for the IC to remain on the highway vantage point since he had a 14-channel handi-talkie (with airnet frequency) and could direct off-fire activities from an on-fire location.

Had the incident commander placed himself on the fire he would have: been able to equate fire behavior with existing and forecasted weather conditions; been able to better judge the adequacy of his suppression forces to contain the fire and directed priority attack; had better control/evaluation of helicopter/air tanker drops; made quicker assessment of the lapse in water delivery and taken prompt measures to alleviate; had better intelligence for ordering reinforcements, including an earlier request for heavy air tanker sorties.

3). **There should have been no modification (deactivation) of resources called for in the initial response under the Toiyabe NF dispatch plan.** An irrefutable, time tested doctrine of wildfire firefighting is: **Hit em hard, hit em fast, keep em small.** The Acorn fire is a classic example where this doctrine should be applied, especially as it pertains to initial mobilization/dispatch of resources.

The Toiyabe Forest dispatch plan (see Appendix G) was developed in 1981 by a team of experts to mobilize and dispatch resources according to fire weather severity, behavior, risk, and values threatened. Subsequently, each year it has been tested and improved; the latest revision occuring in May 1987.

The plan is not ironclad. It can be modified by the incident commander, the district duty officer, or other responsible officer with knowledge of the incident. This was done by the Acorn fire incident commander 1/ upon arrival when he deactivated 4 of 7 engines and two Nevada Division of Forestry suppression crews, one of which was replaced by the superior Category I Silver State hotshots. Undoubtedly this decision was based on what the fire looked like from the vantage point, making it crucial to later events.

While the dispatch plan is a guideline, nevertheless it is time tested and in light of (1) and (2) above should not have been modified with the information that was, and could be, known by the incident commander. In other words, the basic doctrine explained above fully supports "hitting em hard", given the fire weather severity and its behavior at initial attack.

The obvious question is whether these resources would have made a difference in containing the fire at initial attack. Here one enters the realm of probabilities and of speculation.

Suffice it to say, if the 4 engines, additional hand crews and 2 heavy air tankers had been dispatched/employed 2/ without a 2-1/2 hour delay (see Appendix N), the engines certainly would have been available sooner for tactical employment in structure protection at Crystal Springs; perhaps the additional crews in time to reinforce the Silver State hotshots early on, or later at the most advantageous location, and the air tankers for targets of opportunity where most needed.

These delayed resources might, or might not, have made a difference in the eventual outcome of the fire. Too much extrapolation is needed to say one way or the other. My premise is, that under the situation prevailing at the time, and with no other fires in progress, there should have been no modification of the dispatch plan and there would have been unknown benefit from having the delayed resources arrive earlier.

4). **Assistance by local volunteer fire departments was not crucial to success in the initial attack phase.** Much has been said, pro and con, about using the Woodfords volunteers who were some of the first forces to arrive on the old highway below the fire.

First, it should be recognized this was not a typical wildfire, which they may have encountered in the past, on realatively flat ground adjacent to a road where a VFD could take fast action using the equipment and protective clothing they normally use/wear.

It was a fire across a river, 600 feet up a 70 percent slope, on rocky ground with treacherous footing (see Figures 10 - 13), and burning fuels which presented both a safety threat and a suppression challenge even to journeymen wildfire firefighters. As mentioned

1/Who was also functioning as the District Duty Officer.
2/The dispatcher moved one engine to Markleeville and alerted the NDF crews on his own, but they were not committed until ordered by the IC.

frequently above, it was not the "piece of cake" it appeared to be from a vantage point 1/4 mile away.

Second, while the local VFD's had recieved some wildfire training and experience, in my opinion it did not qualify them to make initial attack on this fire. In addition, they did not have approved wildfire protective clothing nor were they well-versed in the use of the protective safety shelter; all of which are mandated on wildfires under Forest Service juristiction.

Third, as attested to by knowledgeable structural fire people (see Appendix O), turnout coats, pants and boots, with which the local volunteers were equipped would have been a hinderance on this fire, not even considering body heat generated by the heavy gear in toiling up a steep slope, much less performing the hard, physical labor involved in wildfire suppression.

The above is not meant to detract from the willingness expressed by the local volunteers in wanting help on the fire, nor their rapid response to the alarm---it was a commendable effort. But this just was not their kind of fire, and in my opinion their presence on the fire would not have been critical to containing it at initial attack.

Their early arrival on the scene was beneficial in they were alerted and able to respond quicker when called to fight structural fires later on.

5). **Once the fire escaped initial attack, it was bound to make the run it did regardless of suppression effort employed.** Fuel dryness, wind, topography, and flame lengths all conspired to make a fire storm which would roll to the east and north until it ran out of fuel or reached the ridge tops.

Normally, wildfires lose their momentum after sundown due to diminished wind, higher humidities, lower temperature and fuel moisture recovery. The fact that severe burning conditions prevailed well into the night, as shown by fire behavior at Mesa Vista and the spot fire above Crystal Springs, is evidence the fire would run its course in spite of man's effort to stop it.

6). **Backfiring tactics employed had no significant impact on further spread of the fire.** There has been criticism about the backfire tactics employed along Highway 88 near the lower Crystal Springs junction. The backfire was ordered by the incident commander and performed by an agency crew, contrary to reports that it was done without orders.

The strategy was to create a burned, fuel depleted, corridor on the north side of the highway which would widen the existing barrier created by the highway and right-of-way, to prevent the fire from moving into Crystal Springs residential area. Simultaneously, the fire would continue its upslope (northerly) advance to be expected under normal burning conditions.

Meanwhile, the fire had started to spot south across the highway below the bridge not long after the backfire operation began. It was also building up and would spot to the east, overriding the natural upslope direction.

In my opinion, the main head of the fire had gained enough momentum (see 5 above) that the backfire would have no effect on its easterly movement. That the strategy, although sound, was too little, too late. On the other hand, there was a slim possibility that it would work and be successful in slowing the main fire advance, giving suppression forces an opportunity to regroup for containment.

7). **Structual protection was adequate considering fire behavior, building flamability, access and water availability.** There have been sweeping statements about agency reluctance/refusal to assist with structural protection during the fire. This generalization has not been substantiated by my interviews.

Admittably, this could have occurred in isolated instances, but I attribute it more to mis-communication, heat of battle emotion, lack of experience/training, dry engine tanks, etc, than to willful lack of cooperation.

On the contrary, I found agency and mutual aid forces to have made all out efforts (see figures 26, 27, & 28) to save lives and homes (sometimes at the risk of their own lives), in spite of poor access and lack of fire safe measures around structures; intermittent water replenishment. The latter situation was agravated by lack of a special key to activate the two Woodfords' hydrants, which have a frost protection feature and also require more turns to start water flow.

The FS and BLM structural protection policy shown in Appendix H, clearly provides for assistance in suppression of these fires when lives and property are threatened. Whether the policy was fully understood and could be followed at the time is left to the events as they occurred during the fire.

8). **Lack of fire safe prevention measures contributed to some structure loss.** Structures which had wood shingle/shake roofs, inadequate clearing of vegetation, needles on the roof, flamable siding, firewood stacked against outside walls or too close to the homes were all in jeopardy of catching on fire or propagating it to other structures if on fire.

Some houses which had all of the above deficiencies survived in tact; others that had fully complied with fire safe measures were lost. Successful (or unsuccessful) suppression and erratic fire behavior probably accounts for most of these anomalies. Nevertheless, experience has shown that fire safe prevention measures pay off in situations like the Acorn fire.

9). **Mutual aid support was an important factor in saving structures.** There can be no question the tremendous mutual aid response of the

Sierra Front Wildfire Cooperators was instrumental in mitigating losses in the fire and in saving lives of those who were slow to evacuate.

The Acorn fire is a prime example of how mutual aid functions in a fire of this magnitude. It also serves to accentuate the need for Alpine County to join the Cooperators as a full-fledged member of SFI. Such a move will not only benefit the County, should future interface fires occur, but allow it to reciprocate in helping its neighbors in similar situations.

10). **The wildland/urban interface problem exists in Alpine County and will continue to grow.** Private forest land with buildable sites is rapidly becoming a premium in California, especially the desirable mountain environment which Alpine County can offer.

People are seeking forest areas for homes as their disposable income increases and their desire for a quality lifestyle grows. In turn the County will see growth into the wildland, bringing with it the challenge to regulate fire safe measures for structures on private land.

11). **There needs to be better cooperation between the County volunteer fire departments and the federal agencies.** There is a decided lack of communication and partnership between the VFD's and the Forest Service/BLM, for whatever reason. The Acorn fire has exacerabated the situation; opened old wounds; created new ones. The time has come to agree to agree and work towards a common solution to mutual problems.

12). **Changing protection agencies on state & private land may not be a panacea.** There is always the temptation to change responsibilities when one percieves something has gone wrong; in this case, recommend a different agency to protect state and private watershed land.

Before such a move is taken it should be realized that only 8 percent of the County is non-federal land; that the federal agencies, principally the Forest Service, will undoubtedly maintain a presence to protect its lands regardless of who protects private watershed lands.

The practicality, not to mention capital investment, of another agency such as CDF duplicating stations in co-located communities needs to be considered. From all this it appears other alternatives should be explored before a decision is made to seek a new protection agency in an area that has relatively low interface fire incidence compared to other counties on the west slope.

RECOMMENDATIONS

My recommendations are focused on measures which Alpine County could take to mitigate a re-occurrence of the loss of property experienced in the fire, and to improve their ability to meet future interface problems which are likely to occur.

The scope of my investigation does not include recommending measures which other agencies, namely the Forest Service, could take to improve their protection procedures. They have conducted their own investigations and would deal with operating deficiencies as they see fit. Therefore I will not have recommendations on Conclusions 1, 2 and 3.

Several other conclusions are statements of fact which are largely self-explanatory and would have no relevance to a recommendation. No further comment will be made on these conclusions.

Following are recommendations which deal with conclusions 8-12:

1). **Enact ordinances which require owners of structures at the wildland/urban interface to take fire safe prevention measures to safeguard their property against wildfire.** The County should adopt existing or model ordinances, obtained from other counties or the California Department of Forestry, which provide at least minimal protection around structures in the wildland setting. There are a number of publications such as:

- Californians Can't Afford Wildfires
- Wildfire Protection, A Guide for Homeowners and Developers
- Protecting Your Home Against Brushfire

which are provided under separate cover, that could be used as source documents.

2). **Develop and implement a community action plan to enlist cooperation of residents in a fire safe prevention program.** The community shares responsibility in achieving a fire safe environment. All the ordinances, laws and enforcement can be to no avail if citizens do not get behind the program and share their load of responsibility. It is a two-way street; County administrators and fire authorities need the support and backing of the residents to make the program a success.

3). **Join the Sierra Front Wildfire Cooperators.** If it was not apparent earlier, surely the Acorn fire would point to the need for the County to become a full participant in the Sierra Front Initiative. Alpine County is virtually alone on the east front of the Sierras in not being a member of SFWC. In my opinion, the time has come to join, with no ifs, ands, or buts to impede the decision.

The SFI is a proven system that has stood the test of time and, as stated earlier, been recognized by the National Fire Protection

Association as one of two outstanding examples of wildland/urban interface programs that accomplishes its mission.

Here again, it will take support from the County residents, particularly the volunteer fire departments. "Not invented here" attitudes, concern over turf and political manuevering must be set aside for the common good to all; there is too much at stake.

SFI is built on trust. Trust your neighbor will be there to help you when the need arises and that you can help during his need. But the system also depends on training, planning and coordination to work. It needs to be ready to function on short notice. Alpine County must be part of it, not just an outsider that benefits without contributing.

4). **Incorporate the national Incident Command System in the County disaster plan.** ICS is not only a means to deal with fire disaster, but it can be used to cope with such things as flood, earthquake, hurricane, civil disturbance and the like. It is the one system which permits all emergency services to work together effectively.

California Office of Emergency Services can assist the County in designing ICS into its disaster plan. Another source of ICS information could be obtained from the study/plan mentioned below.

5). **Carry out the joint study for fire protection in Alpine County proposed by the Toiyabe NF.** This will provide a study of fire prevention, pre-suppression and suppression capability in Alpine County. It will identify areas for improvement and areas that are working well and should be reinforced.

Issues which will be addressed in the study will, if adjudicated and implemented into a joint plan, be very beneficial in improving cooperation of the agencies having protection responsibility in the County with the volunteer departments.

6). **Establish a County Fire Marshal position to coordinate structual fire programs and services.** The County needs a manager to administer its fire program and coordinate the volunteer departments into a viable force internally, and with the federal agencies and SFWC externally.

The Board needs a person who will carry out its fire service policy /programs and have responsibility to represent it in dealing with cooperators.

It would be helpful if the volunteer department chiefs could work with the Board in developing the Fire Marshal's position description, thereby having made a contribution to the responsibility and authority delegated to position by the Board.

7). Support retention of the Forest Service as the agency responsible for wildland fire protection on state and private watershed lands in the County under the present arrangement with the California Department of Forestry. If recommendation Nos. 3 and 5 are adopted I believe there will be viable fire protection provided by the Forest Service on state and private watershed lands, and therefore the County should support continuation of the present agreement when it comes up for renewal.