

**Pacific
Northwest
and Northern
California**

PACIFIC NORTHWEST AND NORTHERN CALIFORNIA

I. INTRODUCTION

1. Topography.
2. Fire weather regions.
3. Fuel types and fire behavior.
4. Strategy and tactics.
5. Safety.
6. Key areas of concern; economic, social, political, and environmental.

II. OREGON, WASHINGTON, NORTHERN CALIFORNIA

A. Topography.

The northwest includes the states of Oregon, and Washington, and two countries in Northern California. Water, volcanic, and glacial events in the region have created a great variety of landforms ranging from coastal dunes to rolling hills and steep, highly dissected hillsides.

The major geological features is the Cascade Range, which runs parallel to the Pacific coastline about 100 miles inland. The Coast Range includes lower elevation mountains close to the coastline.

Other important land features are the Willamette Valley, Puget Trough and the Columbia Gorge, which is a water gap through the Cascade Range. One active volcano, Mount St. Helen, is located on the Gifford Pinchot National Forest. Unstable, or potentially unstable soils are extensive on all forest lands west of the Cascades.

Elevations range from sea level to 12,000 feet.

B. Weather.

Because of the maritime influence, coastal areas are comparatively warm throughout the winter. Summer temperatures are rather cool, because of the Pacific Ocean influence. There is a high frequency of cloudy or foggy days throughout the year.

The rainfall in this region is mostly concentrated in the winter months; summer rainfall is usually very light.

Annual rainfall varies from 60 to 150 inches along the coast, averaging 60 to 80 inches along British Columbia and the South Alaska coastal plains, 80 to 100 inches along the Pacific northwest coast, and as low as 20 to 30 inches in some Northern California coastal sections. Many local areas along the coastal slopes have much greater totals, with some areas receiving over 150 inches; in the Olympic Mountains, annual precipitation

ranges up to 240 inches. The valley systems to the east of the Coast Ranges receive 12 to 20 inches in British Columbia, 30 to 50 inches in Washington and Oregon, and 15 to 20 inches in Northern California.

The combination of high rainfall and moderate temperature results in a buildup of extremely heavy fuel volumes. The maritime influence, particularly along the immediate coast, usually holds the fire danger to moderate levels during most seasons. However, some summers are very dry and warm with high fire danger. During these periods, fires are characterized by high intensities, firewhirls, and long-distance spotting.

The fire season usually runs from June through September. Lightning fires increase in number and severity from the coast inland.

In Northern California, Oregon, and Washington, strong dry north to east winds may produce extreme fire danger in late summer and early fall. Two synoptic weather types produce this critical fire weather.

1. One is a cold-front passage followed by a bulge of the Pacific high extending inland over the coast. The attendant northeasterly winds blowing downslope produce a warming and drying foehn effect.
2. The second type follows when higher pressure develops east of the Cascades at the time a trough lies along the coast. The resulting dry easterly winds will cause high fire danger west of the Cascades. Northeast wind not only keeps the marine air offshore, but also results in adiabatic warming as the air flows from higher elevations down to sea level.

Critical Fire Weather - East Winds.

Sometimes easterly winds occur when the air mass is relatively moist, for example in connection with a storm bringing precipitation to the region. These, however, are not the east winds we are concerned with. East wind in fire control means an exceptionally dry wind from an easterly quadrant that may blow continuously for 24 to 48 hours or longer, sometimes at gale force, and often reaching maximum strength during night and early morning hours. Surface winds of 60 MPH are not uncommon. It is accompanied by relative humidities that remain extremely low around the clock with relief only at night in some of the deeper ravines.

East-wind frequencies over Northwest Oregon and Southwest Washington vary by month, and the pattern of monthly variation differs with elevation. Coming at the end of the usually dry summer period and following the near minimum moisture frequencies of August at

all elevations, September bears the greatest impact of easterly winds as they affect forest fire control. This is the month of the greatest frequency of major east winds at 3,500 to 6,000 feet elevations, of greatest increase in frequency from a previous month at all elevations, and second only to April in frequency of major east winds in exposed valleys below 500 feet elevation.

On an annual basis, east winds are more frequent in the middle elevations (800 to 3,000 feet) than at other levels. In the middle elevations they reach maximum frequency in the cooler months - October through January. Minimum frequency of east winds occurs in June through August. In these months, they are more frequent in the 3,000 to 6,000-foot range than at other elevations.

C. Forest Fuels and Fire Behavior.

1. Major Natural Fuel Types.

Douglas-fir/Hardwood

Natural fuel loading 3 to 33 tons/acre
Average duff depth 2 inches
Spread rate 2 to 10 chains/hour
Flame length 2 to 7 feet
Resistance to suppression 2 chains/person hour

Douglas-fir/Hemlock

Natural fuel loading 14 to 330 tons/acre
Average duff depth 4 inches
Spread rate 1 to 17 chains/hour
Flame length 1 to 13 feet
Resistance to suppression 1 chain/person hour

Subalpine Fir

Natural fuel loading 3 to 36 tons/acre
Average duff depth 6 inches
Spread rate 1 to 6 chains/hour
Flame length 1 to 6 feet
Resistance to suppression 1.5 chains/person hour

Mixed Conifer

Natural fuel loading 7 to 56 tons/acre
Average duff depth 2 inches
Spread rate 1 to 7 chains/hour
Flame length 2 to 7 feet
Resistance to suppression 1.5 chains/person hour

Spruce Cedar

Oak-Madrone

Activity Fuels

Douglas-fir/Hardwood - Clearcut 50 to 250 tons/acre
Douglas-fir/Hemlock - Partial cut 10 to 100 tons/acre
Douglas-fir/Hemlock - Precommercial thinning 1 to 10 tons/acre

D. Strategy and Tactics.

Direct Attack is used on most small fires and spot fires on large fires that are a result of a large fire caused by east wind conditions.

Fires caused by the east winds are badly spotted and have a fingered fire edge. The fire has usually made its run in fast-burning fuel, such as slash or a Douglas-fir old burn, and then burned into green timber or the weather conditions became more favorable. The resulting fire edge is badly fingered; most of it has gone out but numerous spot fires are smoldering as far as a half mile or more ahead. There are many unburned islands inside the main burn and a number of places along the burned edge are still smoking. Weather conditions and the type of fuel make it impractical to build a continuous line and burn out. The area is rough and contains a heavy stand of reproduction.

Control action should consist of direct attack by cold trailing and mop-up of hot spots. In order to facilitate travel through the area and for use later in mop-up work, a foot trail and a system of marking are desirable. The foot trail should be located about center through the **spotted** section in a definite direction. It should be brushed out just enough for rough traveling. Tags showing the number of spot fires may be placed along this trail at the takeoff to each hot spot or series of spots. In some instances it may be desirable to indicate on the tags, the distance and direction of the spots. Lines should be blazed or marked from the foot trail to the spots. On the larger projects, mile markers may be established along the foot trail to better identify sections of the area.

Parallel Attack is the method most commonly used on medium and large-size fires. The average forest fire is too hot because of fuel types and there is too much dense smoke to use direct attack. The key to success is anchor points and a well-timed burn out.

Indirect Attack is not commonly used unless needed to stop the spread of crown fire.

1. Tactical Considerations.

Dozers. In heavy fuels, such as in the Douglas-fir type or in lodgepole, the larger tractors with bulldozers are particularly effective. Very little advanced clearing is necessary except bucking large logs.

It is sometimes advantageous to work two heavy units in tandem so the forward movement is continuous. The first tractor pushes over standing material and the second pushes the debris aside and builds a wide fire line to mineral soil. These large tractors are usually obtainable from road jobs and logging operations, but they are difficult to transport unless a heavy semi-trailer or trailer and heavy truck are available. Be sure to check bridge weight limits before ordering.

Snag Falling. In heavy snag areas, especially in the Douglas-fir Region, a special safety problem is encountered. Many of these snags contain rotten wood and are prone to shedding bark in long sheets, with tops and limbs breaking off. All of these hazards are compounded when the snag is burning. As a result, local professional fallers should be hired and assigned a local falling boss who knows the local snag policy. Snags are a sensitive issue in the area. Most land management agencies have a snag retention policy.

In locating the control line through a snag area, advantage should be taken of stream bottoms, ridges or other rises, areas where the snags are smaller and fewer in number, and locations where the felled snags will cause the least trouble from hot ground fires. The resource advisor should be involved in developing snag-falling guidelines for a specific fire. It is desirable to fall snags that are scattering or might scatter fire across the lines. When there are only a few snags and they are not too hot or dangerous, the recommendation is to leave them. When this is not possible, the most troublesome ones should be worked on first. Often it is possible to locate the control line at the edge of the snag area or at a sufficient distance outside so that sparks from burning snags will fall inside the control lines. However, if the snag area is extensive and there are no prepared or natural breaks to fall back to, it may be necessary to construct the control line through the snags, following felling operations.

Aerial Ignition. Commonly used in prescribed burning because more heat can be generated and it is safer than running personnel through clear-cuts with heavy slash loadings. In the past few years this method has gained wide acceptance in wildland fire suppression. The Geographic Area has certified several Helitorch Modules consisting of six persons each. Adequate planning and timing are critical to success. The helitorch may not be effective in old-growth stands due to a closed canopy in the timber. In these situations, the Aerial Sphere Dispenser may be a better alternative.

Fireline Explosive Teams. Not commonly used in the Geographic Area because of the logistics, safety and security measures needed to implement this tactical procedure, and the limited supply of certified blasting teams.

Water. It is plentiful and is commonly used. Engines, water tenders, hose lays with accessories are plentiful throughout the area. All agencies have water handling specialists that can assist an incident management team in the installation of progressive hose lays in the most adverse terrain. Opportunity is there for gravity water systems.

Project slash disposal crews are excellent in the installation of progressive hose lays. Most local units brush disposal caches have 200 to 300 **M** feet of hose with all the needed fittings. Heavy fuels in this smoke sensitive region requires an aggressive mop-up policy built on the ability to move water regardless of the terrain. Progressive hose lays are built around 1-½ inch mainline, 1 inch feeder lines,

forester nozzles, fold a tanks, Mark III pumps, and water tenders with dump valves. The planning and logistics section should access the water handling needs early and place a balanced order for equipment and personnel.

Air Operations. Air tanker drops are valuable in slash models, young plantations and for protecting high resource values such as cable logging sites. Old-growth canopies break up the drop patterns, usually making them ineffective. The area has a fleet of mostly Type I airtankers under contract that can deliver heavy concentrations of retardant. Check on agency specific guidelines on use of air tankers and lead planes.

Light helicopters are useful for scouting, air tactical safety, lookouts, and logistic operations. Because of the density altitude, and heavy fuels, the water bucket loads on light helicopters are not effective. (The area does not have many fixed-wing aircraft with 9600 channel radios for use by air tactical supervisors).

Type I and II helicopters with water buckets are effective in the various fuel types provided there is less than a 5 minute turn around time from a water source. Water bucket operations can be supported with fold-a-tanks for shorter turnaround times, thus reducing flight costs. Most large and medium helicopters are under a CWN contract. When a CWN helicopter is ordered, the Geographic Area will send a management team. The GTS retardant products can pose a hazard to ground personnel from large unbroken quantities of retardant.

Many helicopter companies have buckets set up to utilize foam. This is a very effective tactic in light to moderate fuels with an open canopy.

Consider use of spike camps rather than daily movement of a large number of crews via helicopters.

Consider rappellers as an option for initial attack and/or construction of remote helispots. Keep in mind, the host unit may need to retain their availability for initial attack.

E. Safety Considerations.

1. Snags and large trees - use professional fallers.
2. Heavy fuels - create dense smoke.
3. Cable logging - cable across canyons.
4. Blow down from east winds - feet never touch the ground, rolling logs.
5. Giardia Lambia - "Beaver Fever," water-borne parasite.
6. Reburn after a ground fire goes through a stand.

7. Usually no night operation period on the Olympic Mountains because of 60 percent plus slopes, snags and heavy fuels.
8. Fuels and terrain make "LCES" difficult to implement.
9. Hypothermia - high elevations and rain.
10. Logging trucks on single-lane, full bench roads.
11. Power lines crisscross major drainages.

F. Other Important Considerations.

1. Value.

- a. Good Douglas-fir sites occur on the bottom half on the slope and are capable of producing 200 cu. ft. (1,100 BF)/acre/year. Sites from mid-slope to higher elevations produce from 150 to 50 cu. ft./acre/year.
- b. Douglas-fir stumpage bid price in 1996 averaged \$600 MBF for old growth, and \$359 MBF for second growth.
- c. Cable logging site (purchase price new equipment).

\$600,000	Portable Tower
6,200	Main Line Cable 1,000 ft. diam. 1-1/4"
5,400	Haul Back Line 2,000 ft. diam. 3/4"
2,700	Straw Line 2,000 Ft. diam. 7/16"
425,000	Loader medium size
<u>213,000</u>	D-6 Dozer
\$1,252,300	(1996 prices)

- d. High investment in plantations, genetic tree improvement and wildlife trees.

2. Social and Environmental.

- a. City watersheds - Seattle, Portland and most incorporated towns.
- b. Smoke management and air quality areas. Sensitive airsheds may affect strategy.
- c. Anadromous fisheries and riparian zones.
- d. Save the old-growth and spotted owls. (9 to 11 million acres) has created unemployment of loggers and mill workers.
- e. Snag policy on federal lands.
- f. Counter cultural and alternative lifestyle areas.

- g. Threatened and endangered plants and animals.
- h. This is a densely populated area and people have a strong interest in environmental issues. Media interest (Local, Regional, and National) will be very high. Expect media aircraft at your incident. Relationships with the media are generally good.

3. Political.

- a. Some Agency Administrators and their organizations are experiencing confusion with the definitions of “confine, contain, and control.”

No longer Federal Policy.

- b. Multi-agency fires. Policies and laws are different for each agency and may result in different strategy and/or tactics for different areas on the same fire.
- c. Local governments are interested in what you are doing.
- d. Suppression tactics that have heavy impacts on the land need Agency Administrators support.
- e. Environmental groups will monitor your actions.

4. Other Considerations.

- a. Most timber companies have strong unions. Request a company liaison officer and never work a union member out of his job category.
- b. The transportation system is approximately 90 percent completed in the commercial forest area. Many of the roads are narrow with frequent log truck traffic during fire season. A good transportation plan with traffic controllers must be developed and implemented early.
- c. Because of the terrain and the cable logging systems, most roads are on the upper half of the slopes and the ridge tops. This often requires fire crews to build line from the top down, requiring extra safety precautions. Refer to NWCG Fireline Handbook, Chapter 4, page 46, for these safety guides.
- d. Mop-up. In a timber sale area, the Timber Sale Contracting Officer should be consulted. A lot of high value timber in a felled and bucked unit can be ruined. These units are often high hazard because of the “jackstrawed”: nature of the felled trees.
- e. Helicopter life-flight units are available throughout the area.

- f. Bonneville Power Administration has numerous high voltage power lines coming from the dams on the Columbia River. Contract should be made early with power company representative because of the wide scale economic impact of shutting down on of these lines.
- g. Oregon and Washington at present do not have strike teams predesignated. Strike teams or task forces ordered by incident management teams may arrive as single resources to be organized into strike teams and task forces at the incident.
- h. Differences exist in suppression priorities, standards, agency values and safety standards. These differences need to be identified early and dealt with on all interagency incidents.
- i. Contract crews, engines, and tenders are available. An individual crewmember earns approx. \$20 hr. Crews should have personal protection equipment. Consider ordering a Contracting Officer's Technical Representative (COTR) if several contract resources are on the incident.

III. EASTERN WASHINGTON, OREGON AND NORTHERN CALIFORNIA

A. Topography.

Eastern Oregon, Washington and Northern California - Forest zones are coniferous. In this Geographic Area, elements of the eastern forests meld with some of those from coastal areas. In addition, forest species mix with species steppe and shrub-steppe communities. The area is typified ponderosa pine forest. The areas include the Klamath Mountains in Northern California, which are characterized by rugged, deep dissected terrain and knife-life ridges. The Blue Mountains of Northeast Oregon and Southeast Washington have variable relief, ranging from moderate to steep with Hells Canyon comprising the eastern boundary of the province.

Central Oregon and Northeastern California have high lava plains characterized by young lava flows of moderate relief, interrupted by scattered cinder cones and lava buttes. The surface layer of pumice varies from a few inches to 20 feet deep in places, and was deposited by air currents during the last major volcanic eruptions. This is a land where rocks float, wood sinks and soil burns.

B. Weather.

Winter temperatures are quite low, and summer temperatures are moderate. Annual precipitation ranges from 10 to 20 inches in the valleys to 40 to 60 inches locally in the mountains. Most of the precipitation falls in the winter and spring in the southern portion of this Geographic Area, while in the northern portion, it is fairly well distributed throughout the year, in most years. Winter precipitation is in the form of snow. In the southern portion there often is widespread rainfall until June, followed by generally light precipitation during the summer.

There is a gradual drying out of forest fuels during July and August with increasing fire danger. Frequent thunderstorms may occur then, but little or no precipitation reaches the surface, so that frequent, severe lightning fires occur in both the Canadian and United States portions of the Geographic Area. Also, extremely low humidities can result from large-scale subsidence of air from very high levels in the atmosphere. Catastrophe fire seasons usually begin with long term drought conditions for months before the outbreak itself. Example Tyee Fire (1994).

The fire season usually extends from June or July through September. The synoptic weather types producing high fire danger. Particularly important are the ridge aloft patterns, which produces warm, dry weather, and the patterns producing high-level thunderstorms.

Large fires occur with the passing of dry cold fronts, usually in late summer (from August on) and early fall. In August of 1984, 18 project fires happened in one day. Notable fire years are 1920, 1919, 1934, 1960, 1967, and 1984, all a result of west or Chinook winds. The first moisture of the fire season usually occurs in late August or early September.

Northern California

The vegetation in this Geographic Area consists of grass in the lowlands, brush at the intermediate levels, and extensive coniferous stands in the higher mountains.

The annual precipitation is generally light, around 10 to 20 inches at lower elevations. Precipitation in the mountains ranges up to 60 inches or more locally. Summers are usually rainless, with persistent droughts common in most southern sections. Widespread summer thunderstorms, with little precipitation reaching the ground, particularly in the mountains of the northern half, occasionally result in several ground hundred local fire within a two or three day period.

The fire season usually starts in June and lasts through September.

Several synoptic weather types produce high fire danger. One is the cold-front passage followed by winds from the northeast quadrant - the same as was described above for the coastal region farther north. Another is similar to the east-wind type of the Pacific Northwest coast, except that the high is farther south in the Great Basin. The Great Basin high type produces the foehn-type mono winds along the west slopes of the Sierras and Coast Range.

High fire danger also occurs when a ridge or closed high aloft persists over the western portion of the United States. At the surface, this pattern produces very high temperatures, low humidities, and air mass instability. Extreme, blow up conditions on fires often occur under this weather condition.

1. Gravity or Foehn Winds.

A Foehn Wind is created by gravity. Typically, heavier air spills over high elevations and races downhill. This type of wind is sometimes referred to as a fall or foehn wind.

Foehn winds also occur when a high pressure system is located in and around mountain ranges. The airflow around the high pressure system causes some of the air to spill over the higher elevations, resulting in a strong wind racing downhill at a phenomenal rate of speed. This causes fuels to dry out. As the temperature increases, wind speed may reach 50 to 70 MPH. Many of the largest fires have been caused by gravity or foehn winds. In Oregon, gravity wind is referred to as an east wind; in Central California, it is known as a Mono; and in Southern California, it is the famous Santa Ana.

The Chinook, a foehn wind on the eastern slopes of the Rocky Mountains, often replaces cold continental air in Alberta and the Great Plains. Quick wintertime thawing and rapid snow evaporations are characteristic. If the cold air is held in place by local pressure and circulation systems, the foehn will override it; or if the cold air stays in the bottoms because of its greater density, the Chinook may reach the surface only in the higher spots. Relative humidities dropping to 5 percent or less, and temperature changes of 30 to 40 degrees F. within minutes are common in Chinooks.

North and mono winds in Northern and Central California, develop as a High moves into the Great Basin. North winds develop if a High passes through Washington and Oregon.

2. Thermal Belts.

In mountainous areas, the height of the top of night inversions, although it varies from night to night, is usually below the main ridges. The height of the warmest air temperature at the inversion top can be found by measuring temperatures along the slope. From this level, the temperatures decrease as one goes farther up or down the slope. At this level are both the highest minimum temperatures and the least daily temperature variation of any level along the slope. Here also are the lowest nighttime relative humidity and the lowest nighttime fuel moisture. Because of these characteristics of the average level to the inversion top, it is known as the thermal belt. Within the thermal belt, wildfires can remain quite active during the night. Below the thermal belt, fires are in cool, humid, and stable air, often with downslope winds. Above the thermal belt, temperatures decrease with height. Thermal belts are common throughout the Geographic Area.

3. Unique Conditions.

Never assume general principles are absolute; on the Fremont NF in Lake County, Oregon the Summers Lake/Winters Rim area has reverse diurnal winds. This rim on the west side of the basin has upslope winds at night and downslope winds during the day. Always check for local abnormalities in weather patterns.

C. Forest Fuels and Fire Behavior.

Heavy pine, fir, and spruce stands dominate the Northern Rocky Mountain area.

Following are the major fuel types. The fire behavior descriptions listed do not reflect the erratic fire behavior that may occur as a result of multiple years of drought and dying forests caused by insect infestations.

1. Oregon, Washington, and Northern California.

Lodgepole Pine

Natural fuel loading 3 to 35 tons/acre
Average duff depth 0.6 inches (OR, WA, CA)
4.5 inches (N. Rockies)
Spread rate 1 to 12 chains/hour
Flame length 1 to 10 feet
Resistance to suppression 2 chains/person hour

Ponderosa Pine

Natural fuel loading 1 to 48 tons/acre
Average duff depth 1.5 inches
Spread rate 3 to 10 chains/hour
(Needle drape bitterbrush 40 to 50 chains/hour)
Flame length 2 to 6 feet
Resistance to suppression 2 chains/person hour

Activity Fuels

Lodgepole pine clear cut 16 to 40 tons/acre
Lodgepole pine partial cut 3 to 35 tons/acre
Ponderosa pine clear cut 22 to 46 tons/acre
Ponderosa pine partial cut 3 to 29 tons/acre
Ponderosa pine Precommercial thin 7 to 28 tons/acre

Brush Fields

Natural fuel loading 5 to 37 tons/acre
Average duff depth 20 inches
Spread rate 7 to 13 chains/hour
Flame length 5 to 7 feet
Resistance to suppression 1 chain/person hour
Generally not a fire problem. Brush fields are a result of old burns.
Mixed Conifer - Pine

Natural fuel loading 2 to 31 tons/acre
Average duff depth 1.5 inches
Spread rate 1 to 13 chains/hour
Flame length 1 to 7 feet
Resistance to suppression 1.5 chains/person hour

2. Key Fuel Problem Areas.

Mountain Pine Beetle - Killed LPP and some PP.

Current infestations:

Oregon - Umatilla, Wallowa -Whitman, Malheur, Deschutes, Fremont and Winema NF's.

Tussock Moth - Killed or partially dead interior Douglas-fir. Most of NE Oregon was hit between 1972 and 1975.

Spruce-Budworm Infestation - The western spruce budworm epidemic, in Oregon and Idaho continues to spread slowly across the area.

Snake River Slopes - Chestgrass/timber interface - Wallowa-Whitman, Nezperce, Bitterroot, Payette, Salmon, Challis National Forests. Extreme rates of spread. Side canyons and local winds that affect fire spread are not normal. Request assistance from local FBA.

Needle Draped Bitterbrush with a Ponderosa pine overstory. Normal classification is a Fuel Model "O" or Fuel Model 2. With the needle drape the Fuel Model reacts similarly to a light slash model, with a ground wind the fuel Model reacts similarly to a medium slash model.

Drought conditions have been prevalent during the past 9 years in many parts of this geographical area. Palmer Drought Index (PDI) readings in 1994 ranged from -4 to -17. PDI readings of less than -4 are considered extreme drought. PDI readings are indicative of the 1000-hour fuel dryness and the intensity of the fire, which in turn affects the strategy and tactics to be employed.

These above problems combined with hot, dry weather, and an unstable atmosphere often result in fuels driven, plume dominated fire behavior. This is especially true when the Haines Index is 4 or greater.

D. Strategy and Tactics.

Direct Attack with the one foot in the black is the preferred strategy. Cold trail when possible to avoid reburns escaping. Direct attack reinforced by a hoselay with laterals every 200 feet is very effective in most fuel types. High work is very effective.

When direct attack is not possible, Parallel Attack is usually successful. Position control lines as close to the fire's edge as possible. Fuels should be turned out as line progresses or as quickly as favorable conditions exist.

Indirect Attack is used when erratic, severe or extreme fire behavior usually has one or more of the following present.

- Presence of firewhirls.
- Prolific crowning and/or spotting.
- Very high to extreme rates of spread.
- A tall, well-developed convection column.

Conducting backfiring operations requires great care in timing. All the conditions must be right and all safety precautions must be in place.

Principles of Backfiring. Except in ponderosa pine-grass types, constructing firelines several hundred feet or further from the main fire and backfiring, has generally resulted in major escaped fires or spotty burns when used in timber fuels. Direct attack, aggressively pursued, will be favored with indirect attack and backfiring used only after all other strategies have been subjected to an Wildland Fire Situation Analysis (WFSA).

1. Tactical Considerations.

Sometimes it is necessary to construct a fireline downhill. This is a hazardous practice when done in fast-burning fuels and steep topography, because of the danger that the fire may cross the slope below the crew and sweep uphill to trap them. A fireline should not be built downhill in steep terrain and fast-burning fuels, unless there is no suitable alternative for controlling the fire; and then only when the following safety requirements are adhered to (See also NWCG Fireline Handbook, Chapter 4, page 46.):

- a. The decision is made by a competent firefighter after thorough scouting.
- b. Fire shelters are mandatory for all assigned personnel.
- c. The heel of the fire is anchored.
- d. The fireline does not lie in or adjacent to a chimney or chute, that could burn out while crew is in vicinity.
- e. Communications are established between the crew working downhill and the crew working toward them, which may be at the heel of the fire. When neither crew can adequately observe the fire, communications will be established between the crews and a lookout posted where the fire's behavior can be observed.
- f. The crew will be able to rapidly reach a safety zone from any point along the line if the fire unexpectedly crosses below them.
- g. Direct attack will be used whenever possible.

- h. If direct attack is not possible, the fireline should be completed between anchor points before being fired out. Firing operations should proceed with assured access to the burned-out part of the fireline or other safety zones.

Build line downhill will usually get you into trouble unless you can burn out as you go.

Hand line construction in timber should be located in fuel types that have low to medium potential for rate-of-spread, heat intensity, torches and crowning.

Cup trench firelines are necessary on most slopes.

Air Operations. In addition to the aviation considerations listed for the northwest are, the following should be considered for the Northern Rocky Mountain area.

Inversions at night will hold smoke in valleys until mid or late morning and make air operations doubtful. Air tankers have a low priority on large fires. In appropriate situations, aerial retardant can be effectively used for:

- (1) Holding action on small fires or spot fires.
- (2) Tactical support to line crews.
- (3) Pretreatment for indirect attack.

Paracargo for camp resupply is an option (24 hr. notice required.)

When using remote airstrips for crew/cargo transport, downloading or early a.m./late p.m. flights may be necessary due to density altitudes.

The PREMO MK III Aerial Ignition System has proved to be an effective tool for burning out and backfiring. The system consists of a dispensing unit that injects spherical containers shaped like ping-pong balls (polystyrene balls that contain potassium permanganate with ethylene glycol). The inject balls are dispensed from a helicopter at a selected rate onto the area to be burned. About 30 seconds from injection time, the chemicals in the ball ignite and start the burning process. The system is a very tool for understory burning. It provides a means to rapidly ignite vast acreages at a very low cost.

Critical Fire Problems are in lodgepole, lodgepole subalpine fuel types where 50 percent of the LP is dead and "jackstrawed."

In these stands, tree moss and dead aerial fuels such as small twigs, have the greatest influence on crown fires. Trees loaded with moss and lichens that extend from the tips of the trees to the ground present the worst conditions, but severe crown fires can start when fine aerial fuels are situated high above the ground if a sufficient amount of ground fuels are present to create intense heat. The

influence of distance from ground to aerial fuels varies with the volume and flammability of ground fuels.

The problem becomes one of Direct vs. Indirect attack. The final decision is usually a combination of both methods based on safety, cost, values at risk and the ability to implement your decision in a timely manner. This decision is similar to the one we discussed in relation to east wind fires in the northwest.

Canyon Country. A parallel or flanking strategy usually works best tied into good anchor points.

Tactical Considerations:

- (1) Make sure you use a lead plane with air tankers for best result.
- (2) Let fire come to the top, rather than build line downhill.
- (3) Maximum, aggressive effort at night is usually successful.
- (4) Make sure operation overhead and crew bosses working the night operational period have seen their division in daylight.
- (5) Burnout is preferred to backfiring.
- (6) If you are building line from the ridgetop to the bottom, find a side ridge that goes all the way. Burnout as you go, leaving a good clean edge with a solid black line.

Camps are often necessary to implement a strategy and are effective in reducing the fatigue of crews. Any time travel from the base camp to the fireline exceeds one hour, seriously consider division size camps. (Camps are recommended, rather than helicopter crew movements.)

Coyote Tactics are sometimes necessary because of logistics. If Coyote tactics are established they are often supplied with helicopter long lines. Timing of load, adequate water, and food are critical.

Dozers are in constant use for fire suppression in this geographic area because of heavy fuel complexes. Dozers are extensively used on large fires as the main line building method. They are more likely to be used where fires have escaped initial attack, rather than during initial attack. Dozers are often used to reopen logging roads ahead of engines.

Fireline Explosives.

- (1) Fireline explosives enable a five-person team to construct fireline at rates of 80 chains per hour in timber with moderate fuel loadings with less environmental impact than conventional methods. The quality of line constructions varies with fuel types. Nearly complete line can be made in light brush, grass,

and timber. Heavier fuel concentrations will require follow-up sawyers.

- (2) The material removed by the blast is shredded and dispensed, eliminating fuel concentration. Mop-up adjacent to the fireline is, therefore, significantly reduced. Mineral soil is usually exposed and loosened by the blast. This provides a ready supply of loose dirt in the fireline. Large logs can be cut with the explosive; but chainsaws are more efficient than explosives if many logs must be cut. There is considerable evidence that a blasted line regenerated vegetation faster than conventional line due to fracturing the subsoil. This improves percolation and seed establishment, reducing soil erosion.
- (3) All explosive work will be under the direct supervision of a qualified blaster. The blaster's certification will specify fireline blasting qualifications. Transportation, use, mixing of component explosives, storage, magazine inspection, and disposal must be done by or under the supervision of a certified blaster.

Wilderness Fires.

Suppression actions and techniques must be selected and implemented to result in the least impact on the Wilderness resource and the least possible long-term evidence of human activity.

It is appropriate to accept moderate risk associated with the use of confinement/containment strategies. The effects of fire are most often more acceptable than the adverse effects, on the Wilderness resources of a control strategy or direct attack. The key is to balance suppression impacts with risk, which will vary in each fire situation (seasonal severity, threat to adjacent management areas/objectives, potential cost/lost).

The Wilderness Act defined Wilderness as an area; "...to be affected primarily by the forces of nature with man's work substantially unnoticeable..."

Fire suppression actions in Wilderness shall be those, which achieve the Wilderness protection objectives, with minimum adverse impacts on the Wilderness resource.

Minimum Impact Suppression Tactics (MIST).

MIST guidelines are used extensively within this area for both wilderness and non-wilderness fires. Actual guidelines are agency specific and should be provided during initial briefings to incident management teams.

E. Safety Considerations.

1. Snags from old fires, bug kill, and drought conditions.
2. Spot fires in subalpine types - aerial fuels and ladder fuels.
3. Density altitude - helicopter limitation.
4. Natural gas pipelines present unique hazards. A "HAZMAT" specialist should be ordered if you are around any of these operations.
5. Communications - difficult to establish in first 48 hours in remote areas.
6. Avoid night work in cliff and heavy snag area.
7. Rock slides after fuel burns off steep slopes.
8. Safety Zones.

It is essential to have firelines anchored to a safety zone or to create safety zones as work progresses along the flanks. Determining safety zone dimensions based on percent slope, height of adjacent timber and adjacent fuel loading is a critical assessment that must be done in a timely manner.

9. Wide variation of fuel types and arrangements.
10. Warning signs of long-range spotting or erratic fire behavior:

Relative Humidity, < 15 percent.

Flame Lengths, > 8 feet.

Live Fuel (foliage) Moisture, < 60 percent.

10 Hour F.M. Below 10 MPH.

1000 Hour F.M. is in 10 to 13 percent range.

Watch your relative humidity recovery rate at night. If it is less than 60 percent, except early, rapid burning.

Haines Index 4 and above.

11. Firewhirls - E-W drainages.
12. Giardia Lambia.
13. Bears are attracted by food, keep firelines clean.
14. Vertical mine shafts in many areas of the west. (Example: John Day area of eastern Oregon.)

F. Other Important Considerations.

1. Financial.
 - a. High unemployment in small mill towns.

- b. Ponderosa pine stumpage bid prices in 1996 averaged \$700/MBF (OR, Wash., and Calif.)

2. Social and Environmental.

- a. High elevation, fragile soils.
- b. Urban-Rural interface - Timber companies have sold off private timber lands to small home developers, companies often cut timber and left slash. (Example, 187,000 Oregon homes, worth \$4.6 billion).
- c. Alternative life style communities.
- d. Environmentalists movement to save endangered species, both plant, and animals. (spotted owl, marbled murrelets and wolves).
- e. People concerned about costs of suppression and wasting taxpayers dollars.
- f. Suppression strategies are costs of suppression and wasting taxpayers dollars.
- g. Roads and Elk Management are in conflict. Fireline rehab work: Must be sure 4x4 cannot drive, or open fireline up to travel.
- h. Sparse populations-mostly agriculture and mining people opposed to more wilderness.
- i. New wilderness area-boundaries; difficult to identify on the ground.
- j. Concern over roadless areas that did not get classified as wilderness.
- k. Deer Winter Range-Diminishing because of subdivision.
- l. Cultural Resources and Archaeologist.
- m. Eastern Oregon and Washington. When chore time comes the local people will go home and return later. Local people are the salt of the earth.
- n. Emphasis is on using local resources. Come mentally prepared to use local resources and provide on-the-job training. Best labor source is tribes, big ranches, and lumber companies.
- o. People are self-reliant, independent and not tolerant of government.
- p. Check out local cultures, which are many, with Geographical Area liaison officers. Respect the mores of each group.

- q. Unemployment of loggers and mill workers is high.
- r. Media interest in Incidents is very strong at the local and area basis. Relationships with the media are generally very good. Expect National Media interest if your incident is in the urban wildland interface.

3. Political.

- a. Many areas have wealthy people who made their fortunes in urban areas and have semi-retired in rural areas. Their philosophies are different from most government employees.
- b. Local government is very interested in what you are doing and very proud of their area.
- c. The National Guard is very active in most states, but the National Guard agreements vary by state.
- d. Need to establish agreements early with other agencies and local governments as to who is responsible for what.
- e. Smoke and air quality is an area of concern.
- f. Numerous radio frequencies are in use by local citizens.
- g. Be prepared for pressure to use local fire companies and telephone companies.

4. Co-op Relations.

California, Oregon and Washington have master co-op agreements with the Forest Service and the Department of the Interior.

- a. Oregon has a guideline for negotiating an inter-agency project fire agreement.
- b. Washington - Firefighters are unionized. A Department of Natural Resources Liaison Officer should be requested to avoid breaking the union agreement.
- c. Most states have a control strategy, which is also written into state law. Confine and contain may not be acceptable strategies.
- d. The National Guard activity support fire operations. Some states have operating manuals for working with fire suppression organizations.
- e. ICS is not understood or accepted at all levels of government.

- f. The Canadian border is very well marked and agreements do exist. Be sure you understand the agreement and do not hesitate to get advice from the local Agency Administrator, Geographical Area Office, or NIFC before you cross the border.
- g. Protection priorities differ between some states and the federal agencies (Ex. Oregon).

5. Other Helpful Tips.

- a. Always try to pick up a Regional Mobilization Plan. The information is invaluable.
- b. Keep a tight rein on air operations, especially the safety procedures. Some National Guard helicopters and pilots are approved for fire suppression use, but not all. Check approvals with local aviation managers.
- c. Concentrate your operations section strength against the weakest point in the fire triangle unless life of property is threatened.
- d. The best policy is in applying suppression tactics that minimize ground disturbance, provided objectives are being met.
- e. Keep good financial records. Most of the states have financial problems and will apply for FEMA funding in the early stages of a major incident.
- f. Life Flight helicopters are used extensively throughout most states. Have your Air Support Supervisor make contact with Life Flight before they are needed to agree on operating procedures.
- g. Multichannel radios can create agency and political problems unless strict adherence to the Incident Radio Communications Plan is followed.