Module 3: Monitoring Fire Behavior

Topic 1: Introduction

Fire behavior

Narration script: On a fire scene, just like in everyday life, a bad situation can get worse if you ignore the signs of trouble and fail to nip the problem in the bud. Given the right conditions, a potentially hazardous fire can turn into a rapidly spreading one burning with a fierce intensity. Your rapidly growing knowledge of fire behavior will help you spot potential changes BEFORE they happen. And in doing so, you and your crew will stay safe while continuing to manage the wildland fire.

Module introduction

If you've gone through this course in the order it has been presented, you'll recognize some concepts already discussed—but the fundamentals of wildland fire fighting are lessons reflected on over and over throughout the course of a firefighter's career. Even if you're a seasoned veteran of wildland fire fighting, you'll find information in this module you should review and consider carefully.

Specifically, this module describes factors influencing a fire including:

- *Fuel characteristics*
- *Fuel moisture*
- **Fuel temperature**
- *Topography*
- *Wind*
- *Atmospheric stability*
- *Fire behavior*

Look familiar? These are the seven factors of the Look Up, Down, and Around rule from the Operations section of your Incident Response Pocket Guide (IRPG). A full version of the IRPG is available in the collection of resources available for this course.

Narration script: As you go through this module, you should be getting the sense that wildland fire fighting requires an eye for detail and evaluation. Like a detective—veteran firefighters have the vision to put together the pieces of the puzzle that drive a fire's behavior. One look at the weather, topography, and available fuels might tell you very quickly how the next minute, hour, or day will go for you and your crew. Fortunately, you'll be packing a pocket reference guide to remind you—it's your IRPG. Many of the rules developed for the IRPG have come as a result of wildland firefighters losing their lives—so remember, they are there for your safety.

Problem vs. extreme fire behavior

One of the overall goals of this course is to get you ready to anticipate and evaluate changes in a fire's behavior based on your evaluation of current conditions. Wildland fire fighting is as much an intellectual and mental exercise as a physical one, and you'll need to stay focused.

Fires rarely go from small fires to extreme *blowups* **without signs pointing the way. Working on the fireline demands your attention to details, and you'll have to monitor your surroundings.**

Fires can quickly change between two states:

Problem Fire Behavior

Problem fire behavior has the potential to hurt you or other fireline personnel if the tactics being used to fight the fire are not being adjusted according to conditions. Problem fire behavior can easily go to extreme fire behavior if you don't recognize the indicators that tell you the fire is changing and that it is time to change your game plan.

Extreme Fire Behavior

Extreme fire behavior is also a problem, but kicked up another notch. Here are some tell-tale signs that the fire is becoming extreme:

- **Rapid rate of spread (ROS)—ROS is the relative activity of a fire in extending its horizontal dimensions**
- **Intense burning**
- **Spotting**
- **Crowning**

Narration Script: Part and parcel of the Look Up, Down, and Around procedures found in the IRPG is the ability to begin to spot and differentiate between problem fire behavior and extreme fire behavior. That's why you and your crew need to be able to read the writing on the wall when it comes to weather, topography, and fuels. Each factor of the fire environment can help you understand a fire's behavior and therefore adjust your tactics accordingly. As you go through the rest of this module, start to piece together the environmental factors that might turn a fire into an extreme situation.

Topic 2: Look Up, Down, and Around

Topic introduction

Wildfires don't just suddenly decide to become unruly. In fact, their behavior is just like anything else's—it's an opposite and equal reaction to an action. If you're paying attention on the *fireline*, you'll be able to observe those actions firsthand and then predict the fire's consequent reaction.

This topic analyzes two types of *fire behavior*—problem and extreme. Problem fire behavior is fire activity presenting a potential hazard to fire personnel if the tactics being used are not adjusted. Extreme fire behavior is the highest level of problem fire behavior and is characterized by:

- **Rapid** *rate of spread* **(ROS)**
- *Intense* **burning**
- *Spotting*
- *Crowning*

This topic will present a list of factors and related indicators to help you determine when a fire is transitioning to problem, or even extreme, fire behavior.

Narration Script: As a wildland firefighter, develop a habit of checking your environment. It is one of the best ways for you to stay safe AND predict when fires will become problematic or extreme. This topic will familiarize you with the indicators of problem and extreme fire behavior and when the fire is likely to make the transition between the two. Because when you can see problem fire behavior, you can bet that extreme fire behavior is just around the corner!

The Incident Response Pocket Guide

Your Incident Response Pocket Guide (IRPG) is a handy tool for field reference for the content we'll cover in this topic.

Much of this topic is based on the Operational section of the IRPG. Use the Look Up, Down, and Around information in this section to help you monitor changing conditions within a *fire environment*—the conditions, influences, and modifying forces controlling fire behavior.

Narration script: Keep your head on a swivel, and don't forget to look up, look down, and look around. If you need a quick Look Up, Down, and Around refresher when you're in the field, take a quick peek at your IRPG. Pay special attention to the indicators in bold print.

The seven factors

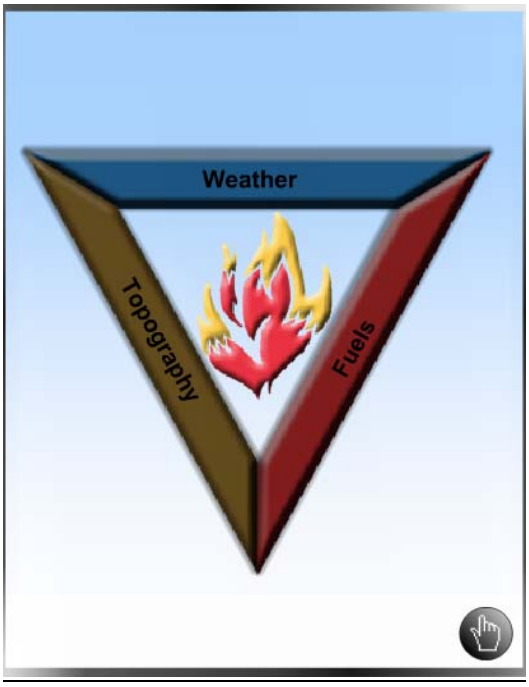
The Look Up, Down, and Around guidelines contain seven fire environment factors you should monitor every time you're at a *wildland fire incident***:**

1. *Fuel characteristics*
2. *Fuel moisture*
3. Fuel temperature
4. *Topography*
5. *Wind*
6. *Atmospheric stability*
7. Fire behavior

Obviously, factors 1 through 3 deal with the fuel side of the fire triangle, factor 4 to the topography side, and factors 5 and 6 with the weather side.

You will investigate each of the first six factors in turn. We'll cover the seventh factor—fire behavior—later.

Narration script: These seven factors and their corresponding indicators provide you with key clues about what to look for when you're monitoring a fire and anticipating what might happen.



Caption: A three-sided triangle labeled "Weather" on the top side, "Topography" on the left side, and "Fuels" on the right side represents each environmental factor's influence, individually or cumulatively, on fire behavior.

Fuel characteristics

Looking down to observe the fuels around you can help you anticipate changes in fire behavior. When assessing fuel characteristics, pay attention to five key indicators, four of which are:

Continuous Fine Fuels

The indicator of continuous fine fuels (fuels distributed uniformly over an area) is the most critical fuel characteristic indicator as identified in your IRPG. Fire is able to change and spread rapidly in these fuels, especially when combined with slope (incline) or wind.

Heavy Loading of Dead and Down Fuels

Stands of trees that have died and fallen down can provide fires with large amounts of readily available fuel.

Ladder Fuels

Ladder fuels (fuels that provide vertical continuity between strata) allow a fire to readily spread into the canopy, launching firebrands (spots) into the air.

Tight Crown Spacing

When tree tops are less than 20 ft. (7 m) from other tree tops, and bush tops are less than 20 ft. (7 m) from other bush tops, a fire can move more quickly and easily from tree to tree or bush to bush.

Narration Script: Let's investigate the fuel side of the triangle, starting with fuel characteristics. When you're at an incident, assess the characteristics of the nearby fuels. These characteristics can help you determine what the fire might do next. If the fire is encroaching on continuous fine fuels, heavy loading of dead and down fuels, ladder fuels, or fuels with tight crown spacing, be aware that the fire could intensify and spread very quickly.

Special conditions

The fifth fuel characteristic indicator is special conditions, meaning any of these situations:

Firebrand Sources

Firebrand sources are burning materials carried by the wind ahead of a fire or outside of control lines.

Potential firebrand sources include:

- **Pine bark plates**
- **Manzanita leaves**
- **Eucalyptus leaves**
- **Maple leaves**
- **Oak leaves**

Numerous Snags

When a fire becomes established in snags (dead or partially dead trees), it can launch firebrands into the air or cause the snags to fall across control lines or to fall on personnel.

Frost and Bug Kill

Frost and bug kill provides more available fuel for a fire.

Preheated Canopy

A lower intensity fire burning the fuels near the ground can preheat canopies. As heat from the fire dries the fuels above it, it makes those fuels available to burn.

Unusual Fine Fuels

Unusual fine fuels are light, flashy fuels mixed with high-energy fuels, such as continuous grass mixed with sage.

High Dead-to-Live Ratio

Wildland areas having greater amounts of dead-to-live materials can provide additional fuel for a fire.

Fuel moisture

Fuel moisture is another factor to consider. Fuel moistures are important for both fine and large fuels as well as dead and living fuels. For example, relative humidity (RH) affects 1-hour fuels much faster than 1,000-hour fuels. Fuel moistures change at different rates depending on the size of the fuel.

When assessing fuel moisture, pay attention to these indicators:

Low Relative Humidity (RH)—Less Than 25 Percent

Moisture in the air is known as relative humidity. RH is the percentage of moisture in a volume of air relative to the total amount of moisture that the volume of air can hold at the given temperature and atmospheric pressure. As identified in the IRPG, low RH is the most critical fuel moisture indicator.

RH can add or remove moisture to fuels. The lower the RH, the more available the fine fuels are to carry fire.

Low 10-Hour Fuel Moisture Content (FMC)—Less Than 6 Percent

The diameter of a fuel affects the length of time it takes for the moisture in the fuel to be equal to the moisture in the air. This factor, in turn, affects the length of time it will take for fuels to ignite if they are exposed to heat.

10-hour fuels are fuels 1/4 to 1 in. (6 to 25 mm) in diameter, such as small branches. If the 10-hour fuels in your area have less than 6 percent FMC, they will be more available to burn.

Drought Conditions

Drought conditions can mean fuels are more receptive to ignition and carrying the spread of fire. A 1,000-hour fuel category can indicate long-term drought. When burning, very dry 1,000-hour fuels can release large amounts of energy and are hard to control.

Seasonal Drying

Regardless of size and shape, all fuels are affected by seasonal changes in humidity. After a prolonged period of warm, dry weather, timber—a 1,000-hour fuel—may actually be drier than kiln-dried lumber.

Warning!

A *general* rule of thumb is that an RH of 25 percent or lower means fire behavior will most likely increase dramatically. Put your head on a swivel when you or someone on the crew identifies an RH level at or below 25 percent. Of course, fuels and your geographic location play some role—so, if you're not sure—ask a supervisor! Tactics may change accordingly in this scenario.

Narration Script: When considering fuel moisture, pay the most attention to relative humidity. Anything less than 25 percent can mean bad news for you when fighting wildland fires. Other fuel moisture indicators include 10-hour fuels with less than 6 percent fuel moisture content, drought conditions, and seasonal drying. On the fireline, rub fuels in your hands to get a feel for how moist the fuels are.

Fuel temperature

As you know, heat energy from the sun warms the earth's surface, heating the surrounding air and the wildland fuels. Heat affects these fuels by reducing their moisture and bringing them closer to their ignition temperatures.

When assessing fuel temperatures, pay attention to three indicators. The first two are temperatures greater than 85° F (29° C) and high percent of fuels in direct sunlight.

High Temperatures

Most wildland fuels require temperatures between 400° and 700° F (200° and 370° C) to ignite. Obviously, solar heating will not cause ignition by itself, but it does make ignition easier. Once a fire has started, radiant heat from the fire dehydrates and preheats surrounding fuels, making them more likely to ignite.

As identified in the IRPG, high temperatures—greater than 85° F (29° C)—are the most critical fuel temperature indicator to observe.

High Percent of Fuels in Direct Sunlight

In the wildland, fuels in the shade are cooler than fuels in the sun, meaning they won't ignite as quickly. As you practice looking down, determine whether the majority of fuels in your area, on any given slope, are in the sun or the shade.

Narration Script: Fuels exposed to heat from the sun can reach 150 degrees Fahrenheit. This means fuels in direct sunlight are more likely to burn than fuels in the shade. When gauging fuel temperature, ask yourself, "On any given slope, are a majority of the fuels in the sun or the shade?" The answer can help you anticipate changes in fire behavior.

Aspect fuel temperatures

The final fuel temperature indicator is increasing *aspect* fuel temperatures. Being aware of which slopes are "hotter" throughout the day will allow you to monitor where the potential for the greatest fire behavior is.

To be able to determine aspect fuel temperatures, know which slopes tend to have higher fuel temperatures in the morning and which ones have higher temperatures in the afternoon. Consider slopes facing south and southwest, and north.

South and Southwest Slopes

Generally, south- and southwest-facing slopes:

- **Are more exposed to sunlight**
- **Have lighter and sparser fuels**
- **Have higher temperatures, lower humidity, and lower fuel moisture**
- **Are the most critical in terms of start and spread of fire**

North Slopes

Usually, north-facing slopes have more shade, causing:

- **Heavier fuels**
- **Lower temperatures**
- **Higher humidity**
- **Higher fuel moistures**

Narration Script: Just like fuels in the shade are cooler than fuels in the sun, fuels on north-facing slopes are less affected by solar heating than fuels on level and south-facing slopes. There are ways of measuring fuel temperature precisely, but this is not normally done in the field.

Knowledge Check 1

Multiple choice—check the box of the answer(s) you choose.

Identify the THREE fuel factors MOST indicative of factors leading to problem or extreme fire behavior.

- ☐ **Moisture**
- ☐ **Aspects**
- ☐ **Types**
- ☐ **Characteristics**
- ☐ **Sizes and shapes**
- ☐ **Temperature**

The correct answers are characteristics, moisture, and temperature.

Topography

Topographic elements (terrain) can be like a roadmap pointing out the path of a fire's direction, and they can also act as warning signs. Be sure to look around and scout the topography to help you anticipate changes in fire behavior.

When assessing the terrain, pay attention to five key indicators:

- **Steep slopes**
- **Chutes**
- **Saddles**
- **Box canyons**
- **Narrow canyons**

As identified in the IRPG, steep slopes and chutes are the two most critical terrain indicators. We'll describe each of the five topographic indicators in turn.

Steep Slopes

Pay special attention to slopes with inclines greater than 50 percent. They encourage rapid ROS due to convective heating and increased potential for rollouts below the fire.

The flames of a fire on a slope can preheat, dehydrate, and ignite the fuels located uphill much faster than downhill because of their closer proximity. The steeper the slope, the more preheating of fuels—thereby creating a faster moving fire. On the other hand, a fire at the top of a slope is less able to preheat the downhill fuel and tends to burn slower.

Chutes

Chutes are another type of terrain to pay special attention to. A *chute* is a steep V-shaped drainage area that can easily channel smoke and fire upward at a rapid rate. Slow-burning fires in wide canyons can blow up as they enter a chute. Chutes can also alter the flow of surface winds and produce erratic fire behavior.

Even in the absence of wind, these formations can change a fire's ROS and direction of spread by acting as *chimneys* and literally propelling the fire up as if through a stovepipe.

Saddles

A *saddle* is a common name for the depression between two adjacent hilltops. Slow-burning fires in wide canyons can blow up as they enter a saddle. Saddles can also alter the flow of surface winds and produce erratic fire behavior.

Even in the absence of wind, these formations can change a fire's ROS and direction of spread. They allow heat to rise rapidly, and a chimney effect is created.

Box Canyons

A *box canyon* is a canyon with three steep sides and only one way in and out. Fires starting near the base of box canyons may react similar to a fire in a wood-burning stove or fireplace. Air will be drawn in from the canyon bottom creating very strong upslope drafts. These upslope drafts create rapid ROS up the canyon, also referred to as the chimney effect.

This effect can result in extreme fire behavior and can be very dangerous.

Narrow Canyons

Radiant and convective heating can increase spotting across narrow canyons. Also, fire can burn down to the bottom of the canyon and then cross over to the other side. This is known as *slope reversal*. Also, expect wind eddies and strong upslope air movement at sharp bends in the canyon.

Narration Script: Let's consider the topography side of the triangle. Topography is essentially the terrain or "lay of the land" but includes man-made structures. "Topography" or "terrain" includes the shape of the landscape, its elevation, steepness, the slope, and the direction that slopes face—known as the "aspect." Local topography affects a fire's intensity, rate, and direction of spread.

Knowledge Check 2

Matching—select the match you choose from the pull down list.

Local topography affects a fire's intensity, rate, and direction of spread.

Match each type of terrain with its specific effect on fire.

Steep slopes	Draw air in and create very strong upslope drafts
Chutes and saddles	Draw air in and create very strong upslope drafts
Box canyons	Draw air in and create very strong upslope drafts
Narrow canyons	Draw air in and create very strong upslope drafts

The correct matches are as follows:
Steep slopes: Encourage rapid ROS due to convective heating
Chutes and saddles: Allow heat to rise rapidly, creating a chimney effect
Box canyons: Draw air in and create very strong upslope drafts
Narrow canyons: Increase spotting due to radiant and convective heating

Wind

Of the seven fire environment factors you should monitor every time you're at a wildland fire incident, wind is the most variable and least predictable. It is the primary factor influencing wildland fire spread.

Wind adds to the unpredictable nature of fire spread and delivers more oxygen to the fire. When observing the wind, pay attention to seven key indicators:

- **Surface winds above 10 mph (16 km/h)**
- **Battling or shifting winds**
- **Lenticular clouds**
- **High, fast moving clouds**
- **Approaching cold fronts**
- **Cumulonimbus development**
- **Sudden calm**

As identified in the IRPG, the first two factors in this list are the two most critical wind indicators. You'll investigate each of the seven indicators in turn:

Surface winds above 10 mph (16 km/h)

Pay special attention to surface winds. They:

- **Help determine the direction of fire spread**
- **Help to carry firebrands ahead of the fire**
- **Increase the supply of oxygen to the fire**

Take a moment to review the graphic. It depicts a burnout operation with steady 15 to 20 mph (24 to 32 km/h) winds. Notice how the wind has leaned the column of smoke. Even though the wind speed isn't very high, it still has a serious effect on the fire.

Caption: A section of tall pines to the left of a constructed fire line. Lengthy flames and billowing black smoke are rising from the pines. The black smoke and flames are both leaning heavily to one side, clearly indicating the wind is blowing steadily.

Battling or Shifting Winds

Battling winds **change direction and then return to the original direction. Battling or shifting winds indicate a probable change in wind speed and direction. Pay close attention to these types of winds because changes in wind speed and direction:**

- **Affect everyone on the fire**
- **Can cause firebrands to cross control lines**

Also, increasing winds can cause previously quiet parts of the fire to intensify.

Lenticular Clouds

Lenticular clouds are:

- **Stationary**
- **Lens shaped**
- **Formed at high altitudes**
- **Normally aligned at right angles to the wind direction**
- **Indicative of high winds aloft with the potential to surface**

High, Fast Moving Clouds

High, fast moving clouds indicate a potential for wind shifts.

Approaching Cold Fronts

When a cold front advances on a warm front, it produces dramatic results making a fire extremely difficult to control. A cold front's influence includes:

- **Gusty winds changing direction sharply and distinctly**
- **Surface winds altering natural convection currents, causing longer horizontal flames, and resulting in preheated fuels**
- **Strong, shifting winds causing erratic wildland fire behavior and increasing the potential for spotting downwind**
- **Strong winds developing high heat outputs in active fire heads and flanks (sides)**

Cumulonimbus Development

Cumulonimbus clouds are anvil shaped and usually accompanied by lightning, thunder, hail, and strong winds. They indicate possible wind speed and direction and the potential for erratic winds.

Sudden Calm

If the wind suddenly dies down, it may spring back up again in a different direction—completely changing the direction of fire spread previously forecasted.

Narration Script: Let's investigate the weather side of the triangle, starting with THE primary factor influencing wildland fire spread—WIND. Winds push the fire at a faster rate and potentially push the fire toward new fuel sources. Additionally, wind can pick up fire embers and transfer them to other areas, igniting other fuel sources and creating spot fires. Wind can be your worst enemy.

Atmospheric stability

Atmospheric stability is another fire environment factor to monitor when you're at a wildland fire incident. More specifically, you should be on the lookout for clues pointing to atmospheric *instability*. Unstable air tends to increase the potential for gusty surface winds and, thus, fire activity. When the air is unstable, wildland fires burn hotter and with more intensity.

The seven indicators of atmospheric instability are:

- **Good visibility**
- **Gusty winds and dust devils**
- **Cumulus clouds**
- **Castellatus clouds in the morning**
- **Smoke rising straight up**
- **Inversion beginning to lift**
- **Thermal belt**

The first five indicators show unstable air mass, meaning a fire has the increased potential to grow rapidly. You'll examine each indicator in turn:

Good Visibility

Your eyes can help you spot atmospheric stability indicators. For instance, when the air is unstable, visibility is good.

Gusty Winds and Dust Devils

Gusty winds make it difficult to accurately predict a fire's movement and behavior. Not only do gusty winds tend to shift erratically—moving the fire in different directions as they do, but gusts can also pick up and spread embers, causing spot fires and producing dust devils.

Dust devils are small, rotating windstorms containing sand or dust. They occur on hot days, over dry ground, when skies are clear and winds are light. Under intense heating, air near the ground rises in upward spiraling motions, in columns or chimneys.

Cumulus Clouds

Cumulus clouds are generally easy to spot as they are slightly "fluffy" and have rounded tops with a flat base. These cloud formations have vertical air currents indicating unstable atmospheric conditions and the possibility of gusty or strong winds. The heights of cumulus clouds indicate the depth and intensity of the instability.

Cumulus clouds herald the arrival of cold fronts and thunderstorms.

Castellatus Clouds in the Morning

Castellatus clouds consist of separate towers of clouds rising from a flat middle level base. When you see these clouds in the morning, they often indicate an approaching thunderstorm.

Smoke Rising Straight Up

When the air is unstable, smoke will rise vertically, almost in columns.

Inversion Beginning to Lift

Increased wildland fire behavior is almost certain when inversions—warm air over cold—break or lift due to heating the lower atmosphere by the sun or a fire. When the inversion lifts, it indicates the transition from a stable to an unstable atmosphere. While the breaking up of an inversion is usually gradual, it can occur quite rapidly; when it does, fire activity can increase dramatically and threaten the fire fighting effort.

Watch for these indicators when an inversion breaks:

- **Increase in temperature**
- **Decrease in RH**
- **Increase or shift in wind**

Thermal Belt

A *thermal belt* is the top of an inversion layer. "Thermal" means warm, and the top of the inversion layer contains the warmest air temperature. This area is characterized by the:

- **Least amount of variation in daily temperatures**
- **Highest average temperature**
- **Lowest average humidity**

Wildland fires within the thermal belt can remain quite active during the night.

Narration script: Stable air discourages the vertical movement of air and tends to reduce fire activity, while UNstable air encourages the vertical movement of air and tends to increase fire activity. Get to know the indicators of an unstable atmosphere because when the air is unstable, wildland fires burn hotter and with more intensity—making your job that much more difficult and dangerous.

Knowledge Check 3

Multiple choice—check the box of the answer(s) you choose.

When you're working to put out an active wildfire, take a minute every now and then to look up, down, and around. When you look up, identify the types of clouds to predict wind movement and the possibility of atmospheric instability.

Identify the type of cloud having an anvil-shaped appearance.

- ☐ **Cumulus clouds**
- ☐ **Cumulonimbus clouds**
- ☐ **Castellatus clouds**
- ☐ **Lenticular clouds**

The correct answer is cumulonimbus clouds.

Fire behavior indicators

Fire behavior is the final fire environment factor to monitor when you're at a wildland fire incident. By understanding the variables affecting fire behavior, you can reduce the risk involved in *fire suppression*.

There are eight indicators of a rapidly changing, wind-driven fire with intense burning. The first four pertain to columns of smoke and usually signify an increase in fire behavior:

- **Leaning column**
- **Sheared column**
- **Well-developed column**
- **Changing column**

As identified in the IRPG, a well-developed column is one of the three most critical fire behavior indicators to watch for. This is because they can make their own weather, affecting the winds in the area and the fire area itself. These columns can also lean over (collapse) over unburned areas causing spotting.

Narration Script: Now that you've looked at each side of the "look up, down, and around" triangle, it's time to dive into the last factor—fire behavior. As you've learned, fire behavior is affected by a variety of fuel, topography, and weather factors. We'll now cover the indicators of a fire's probable behavior.

Other fire behavior indicators

The remaining four indicators of a rapidly changing, wind-driven fire with intense burning are:

- **Torching**
- **Frequent spot fires**
- **Smoldering fires picking up**
- **Small firewhirls beginning**

As identified in the IRPG, torching and frequent spot fires are two of the three most critical fire behavior indicators. We'll describe each indicator in turn.

Torching

A *torching* fire is a vertical phenomenon where a surface fire periodically ignites the crown of a single or small group of trees or shrubs before returning to the surface. Typically, when trees begin torching, the fire is beginning to transition from a surface fire to a *crown fire*. Pay close attention when you see trees torching.

If you see trees torching, note:

- **Whether just one tree or shrub is torching or small groups of trees or shrubs are catching fire**
- **Whether wind is blowing—and if it is, how fast it is blowing**

Frequent Spot Fires

Spot fires **are fires starting outside the perimeter of a main fire. Pay close attention when you see the number of spot fires increasing. Frequent spot fires indicate the fire is:**

- **Spreading**
- **Increasing in complexity**

Smoldering Fires Picking Up

Smoldering fires **are fires burning without flame and barely spreading. Smoldering fires picking up (flaming up) indicate that fire behavior is increasing. Some possible reasons for the pickup include:**

- **An inversion is lifting**
- **Wind is increasing**
- **Shading has decreased on that aspect and temperature is increasing**
- **RH has decreased**

Small Firewhirls Beginning

Firewhirls **are spinning vortex columns of ascending hot air and gases rising from a fire and carrying smoke, debris, and flames aloft. When small firewhirls begin forming, the fire is increasing in intensity.**

Knowledge Check 4

Multiple choice—check the box of the answer(s) you choose.

There are eight indicators of a rapidly changing, wind-driven fire with intense burning.

According to the IRPG, identify TWO indicators you should pay special attention to.

- ☐ **Changing column**
- ☐ **Well-developed lenticular clouds**
- ☐ **Trees torching**
- ☐ **Running fires picking up**
- ☐ **Frequent spot fires**
- ☐ **Small firewhirls beginning**

The correct answers are trees torching and frequent spot fires.

Topic summary

The seven fire environment factors can help you identify and assess problem and extreme fire behavior.

By now you should be able to recognize each of the seven "look up, down, and around" factors and their key indicators. Here's a recap:

1. Fuel characteristics
2. Fuel moisture
3. Fuel temperature
4. Topography
5. Wind
6. Atmospheric stability
7. Fire behavior

And here's a parting tip: always monitor ALL of the factors, not just one or two of them, and monitor the trends of each indicator as well.

Narration Script: Make it a habit to check your environment regularly. Each time you look up from whatever task you're carrying out, monitor all seven of the fire environment factors and the trends of each indicator. Doing so will help you manage the fire situation and stay safe.