

# The Wildland/Urban Interface



Fire Behavior and the  
Wildland-Fire Environment

A photograph of a forest fire. A dirt path leads through a forest of tall, thin trees. The ground and the lower branches of the trees are covered in bright orange and yellow flames. The sky is a hazy, light blue. The overall scene is dramatic and intense.

**Fire Behavior and effects  
In the creation of a  
Defensible Space  
Strategy**

# Objectives

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Information regarding:



- Ruidoso's wildland fire challenges
- Understanding the wildland fire environment
- Factors influencing wildfire behavior
- Using wildfire behavior to develop a defensible space Strategy

# The Wildland Fire Problem

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New Mexico has one of the most severe wildland fire problems in the world because of:

- Population

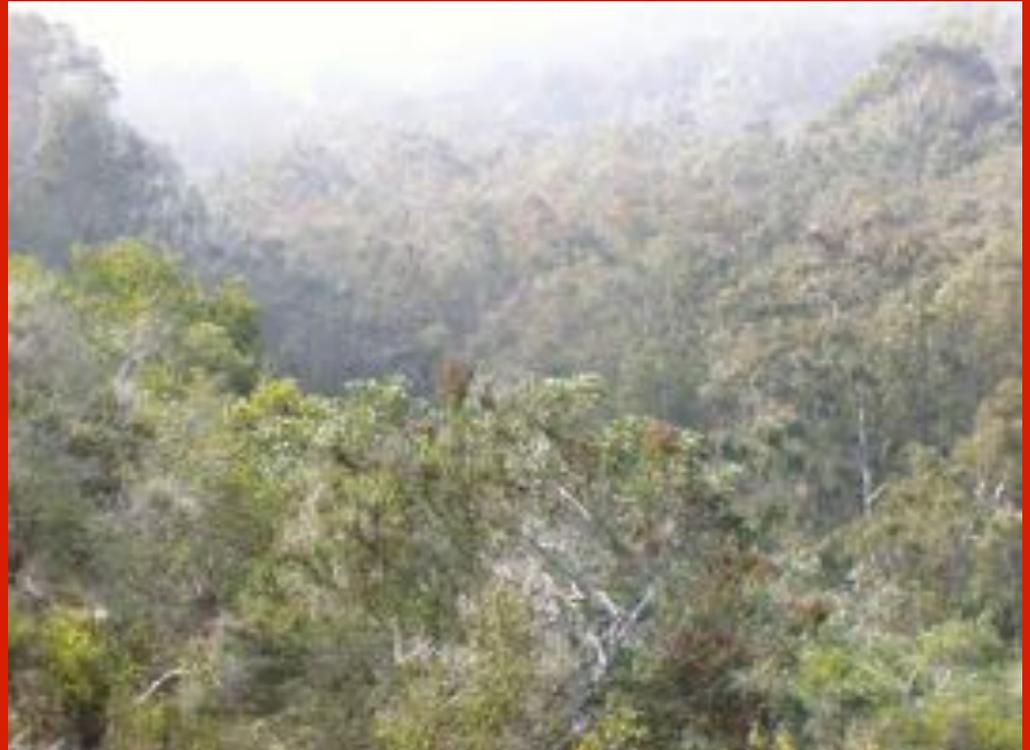


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- Vegetation



# The Wildland Fire Problem

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- Population
- Vegetation
- Topography



# The Wildland Fire Problem

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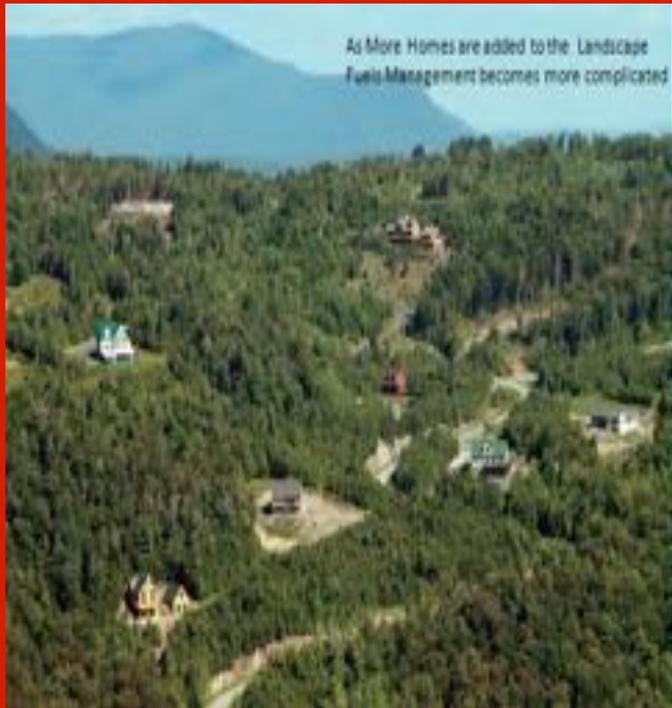
- Population,
- Vegetation,
- Topography, and
- Climate



In wildland/urban interface areas, wildfire isn't a matter of "IF," it's a matter of "WHEN."

# Local Conditions

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In New Mexico, thousands of people choose to build homes within or near wildland areas.

These areas are covered with flammable, native vegetation.

This environment may be desirable but it comes with consequences.

# Local Conditions

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## VEGETATION = FUEL

In mountain areas, forests with dense vegetation, steep canyons, strong winds and high temperatures are common.



# Local Conditions

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## VEGETATION = FUEL



New Mexico's native plants and shrubs are among the most flammable in the world.

Local hillsides and canyons are covered with these flammable plant materials.

# The Wildfire Environment



# How a Fire Burns...

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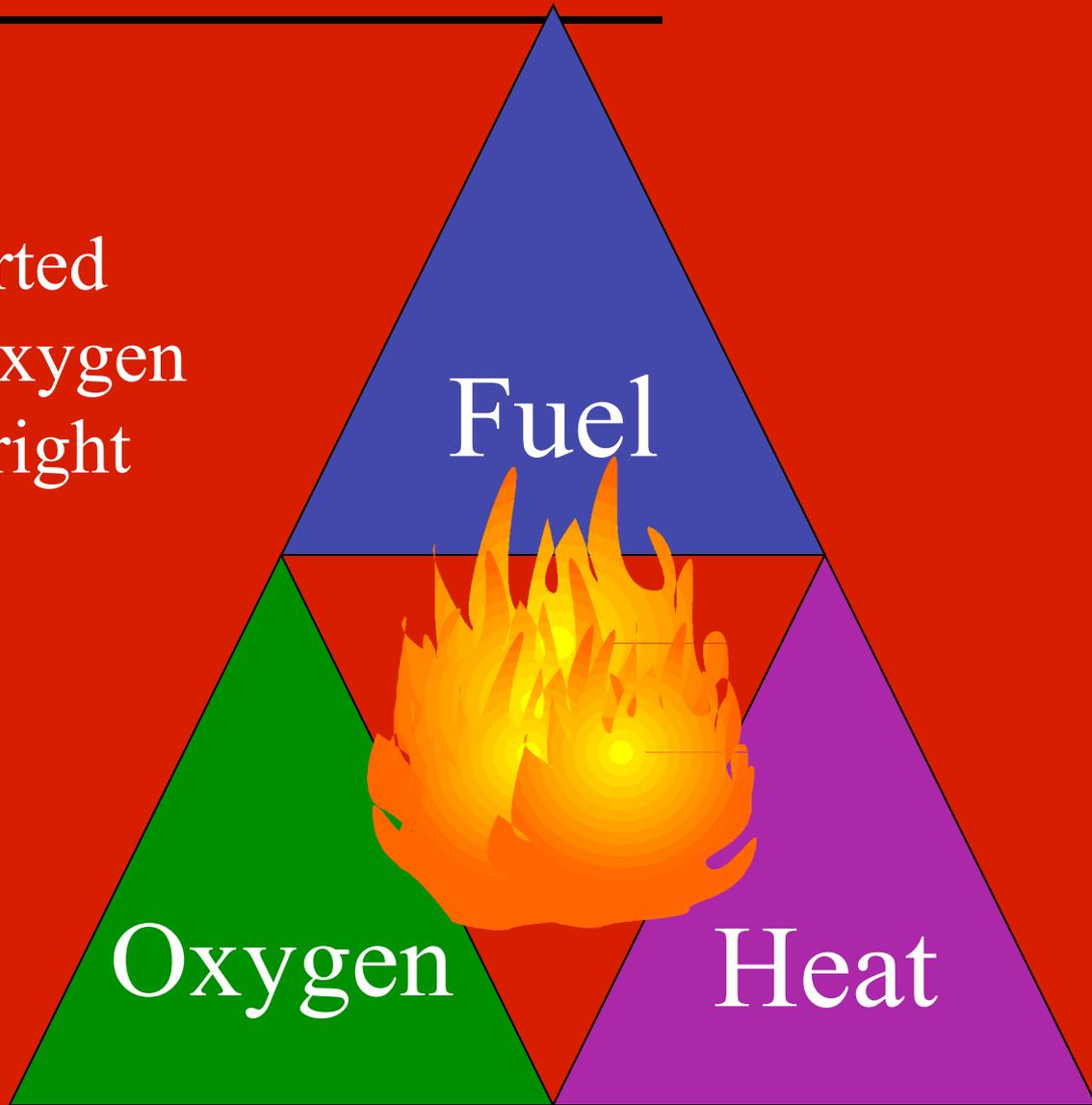


The act of burning is  
**COMBUSTION**

# How a Fire Burns...

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Combustion is supported when fuel, heat and oxygen (air) combine in the right amounts.

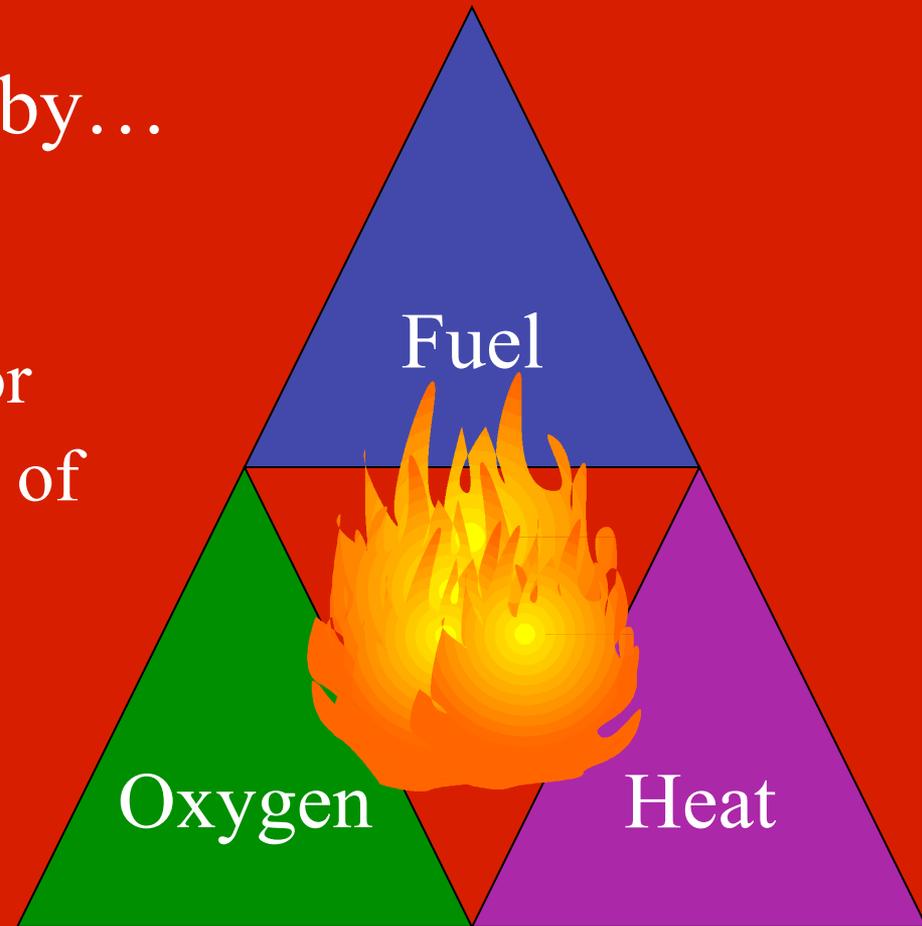


# How a Fire is controlled

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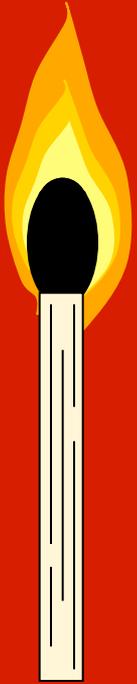
Combustion is interrupted by...

- Removing the fuel, or
- Removing the oxygen, or
- Cooling the temperature of the fuel



# How a Fire Spreads...

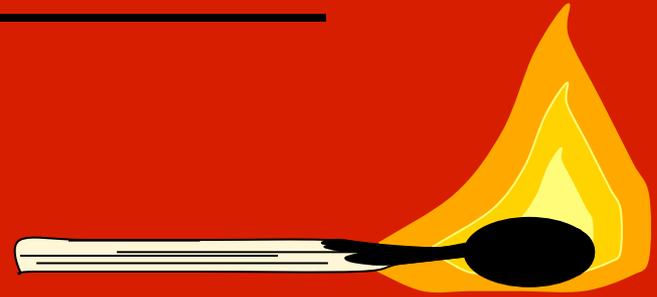
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Transfer of heat  
by contact

**Conduction**

*Slowest*



**Conduction and Radiation**

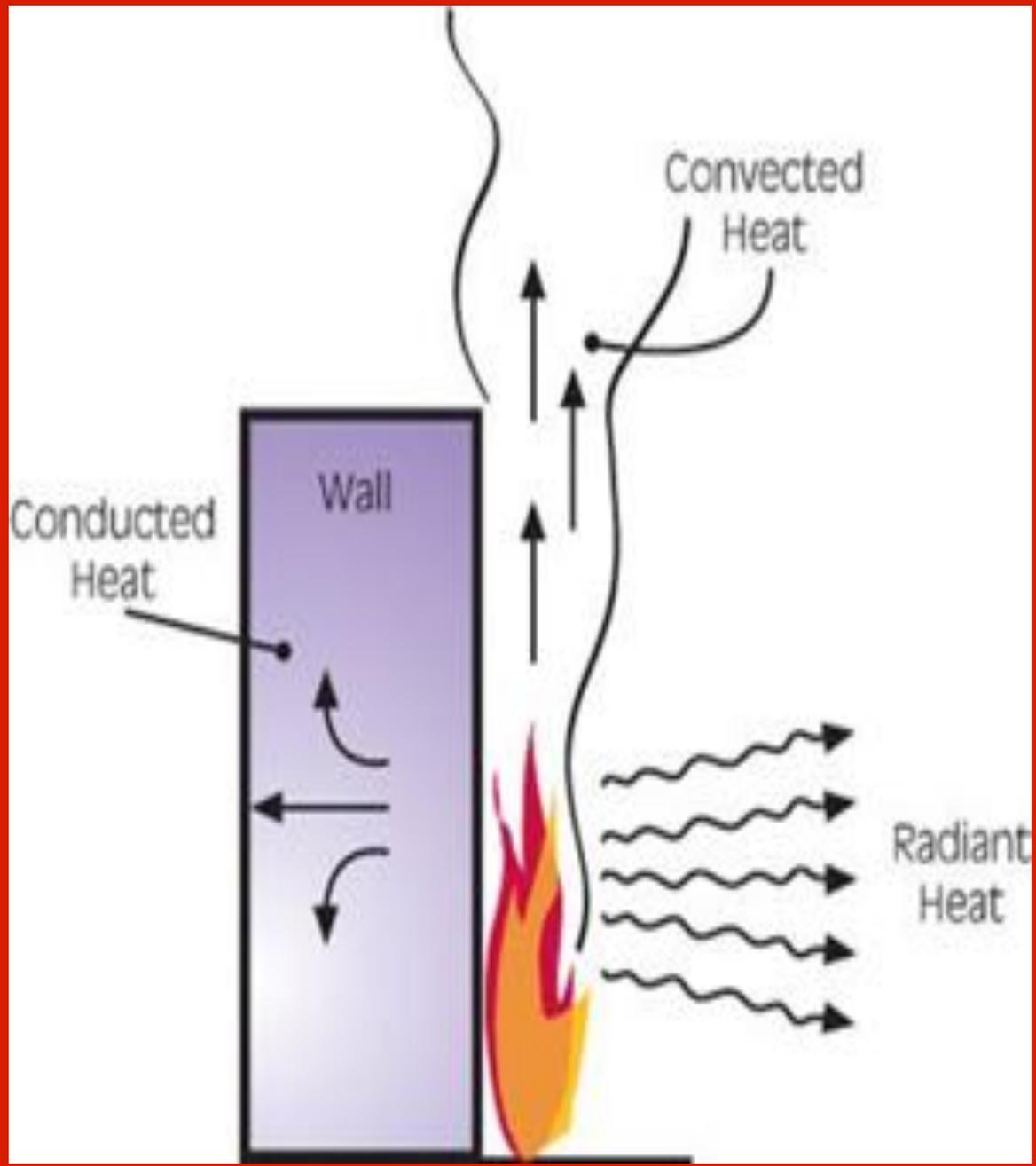
Transfer of heat by contact  
& through the air

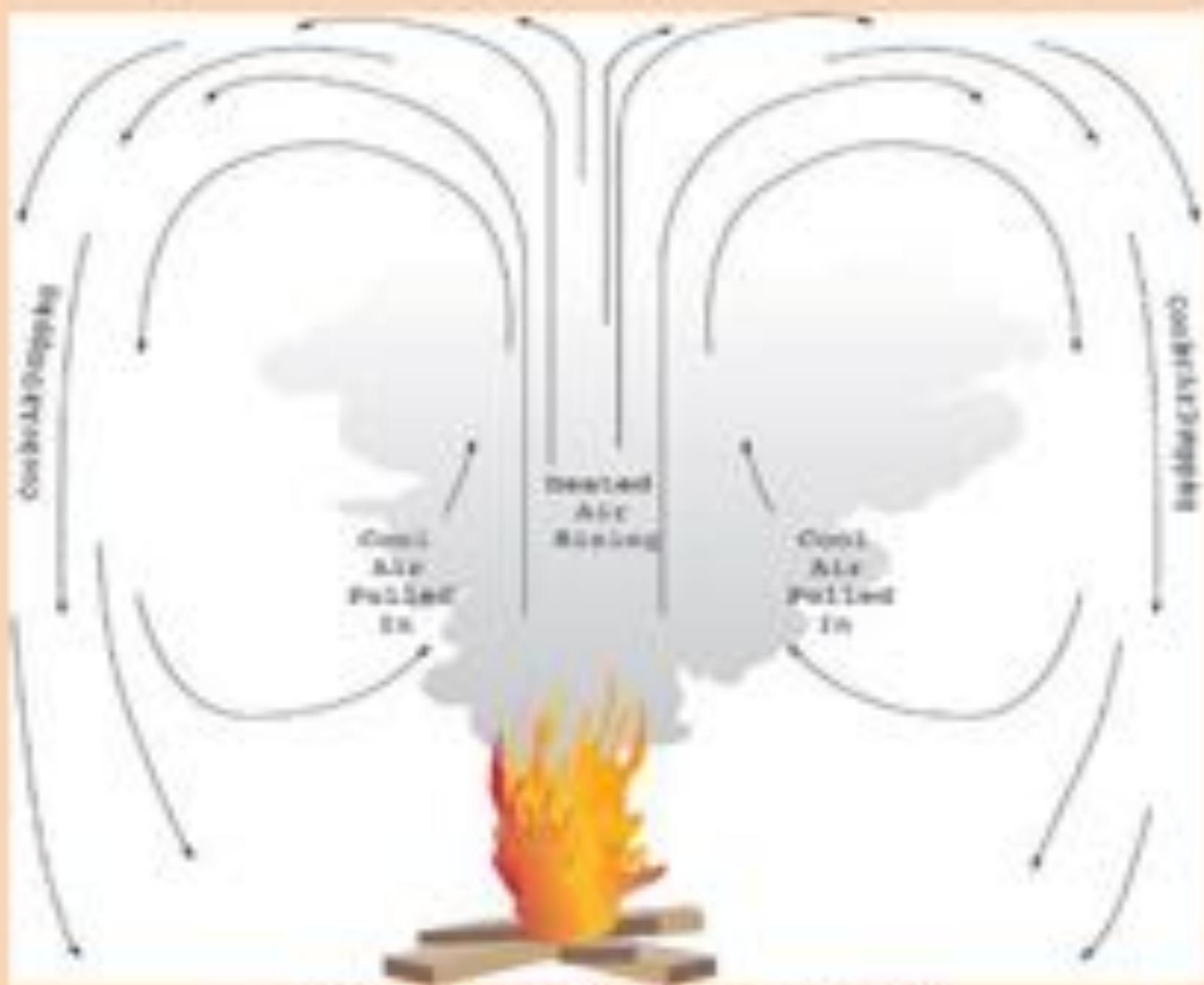


**Conduction, Radiation,  
and Convection**

*Fastest*

Transfer of heat by contact,  
air and direction (rising)



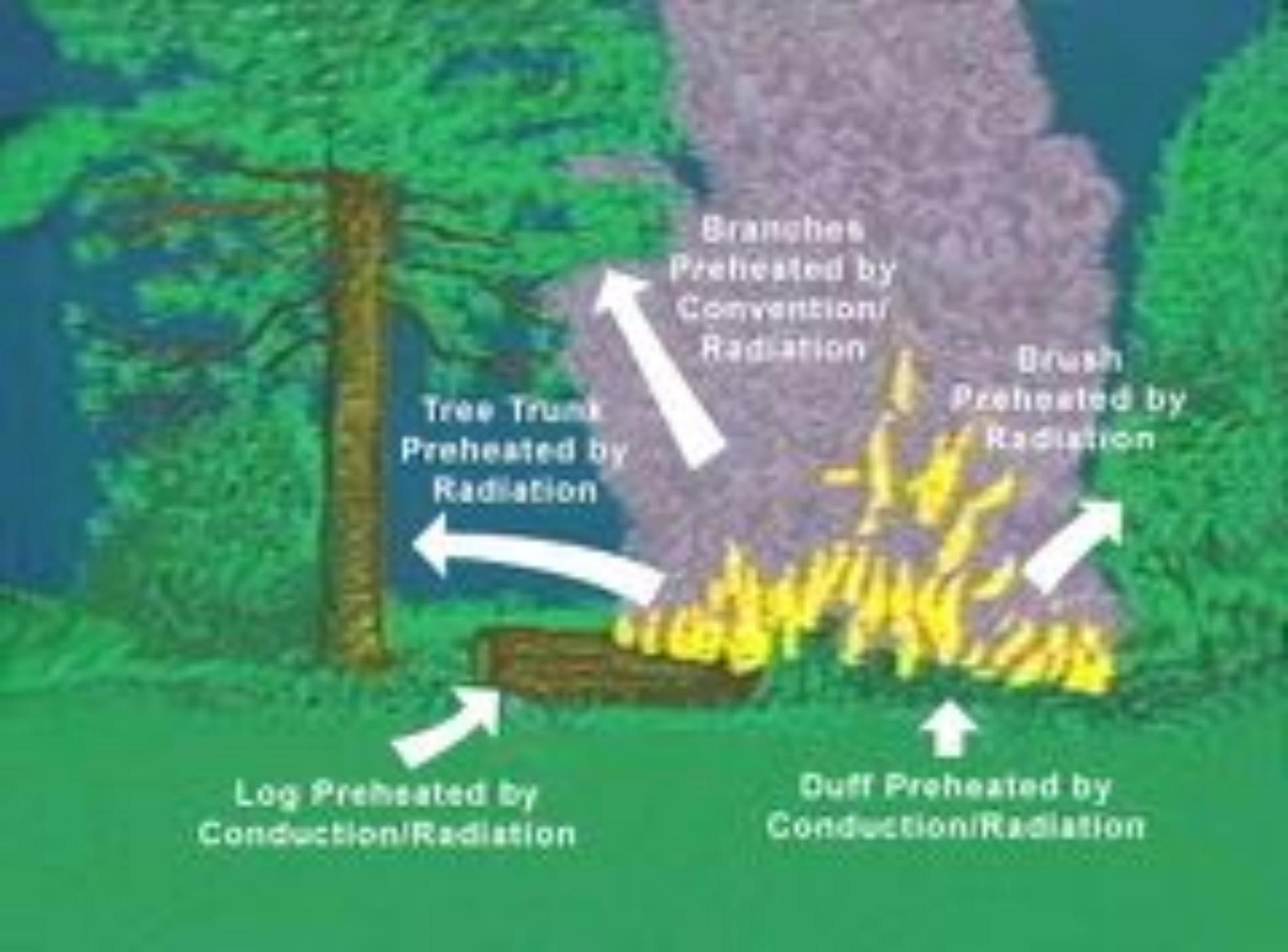


Convection Plume Created by Rising Heated Gases









# Radiant Heat Transfer is increased When:

**FUELS ARE UPSLOPE FROM FIRE**



**FLAMES ARE BENT BY THE WIND**



**FUELS ARE CONCENTRATED**



CONCENTRATED FUEL

SPACED FUELS

# How a Fire Spreads...

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Factors that influence ignition and fire spread:

- ✓ Fuels
- ✓ Fuel moisture
- ✓ Fuel size
- ✓ Fuel continuity
- ✓ Vertical spacing
- ✓ Horizontal spacing



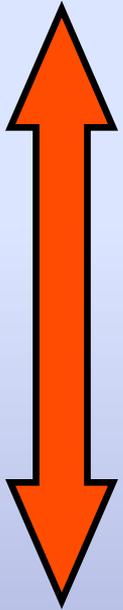
# Vertical

# Arrangement

- Ground

- Surface

- Aerial



# Ground Fuels

All combustible materials lying beneath the surface including deep duff, roots, rotten buried logs, and other organic material.

Usually called a  
“PEAT FIRE”

# Surface Fuels

All materials lying on or immediately above the ground including needles or leaves, grass, downed logs, stumps, large limbs and low shrubs.



Underburn



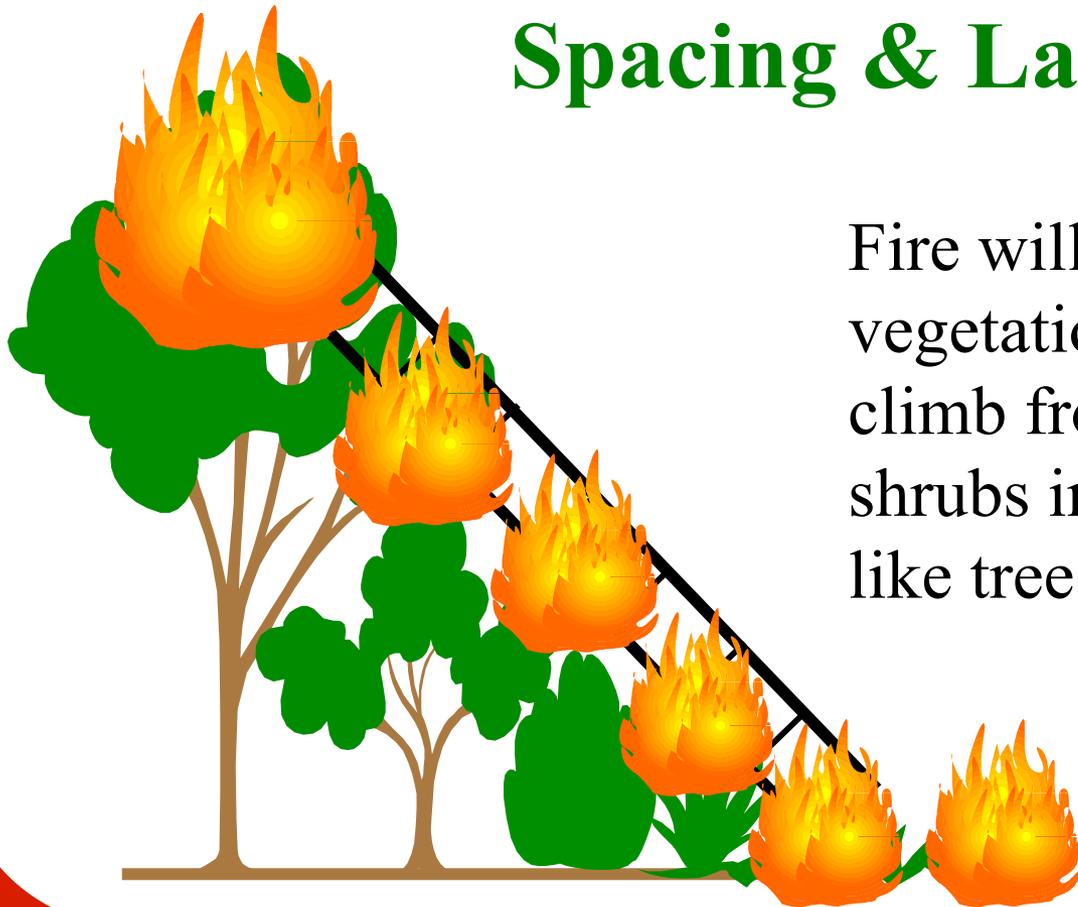


**Surface Fuels**



# How a Fire Spreads...

## Spacing & Ladder Fuels



Fire will use tightly-spaced vegetation as a “ladder” to climb from surface plants and shrubs into aerial vegetation, like tree canopies.

Convection :  
Heat Rise  
Ladder Fuels





Ladder Fuels

# Aerial Fuels

All green and dead materials located in the upper forest canopy including tree branches and crowns, snags, moss, and high shrubs.



# Burn Enhancers found in Urban Interfaces





Concentrated Fuel Pellet



**Horizontal Continuity:**  
**Uniform vs Patchy**

Patchy Fuels



Uniform and Continuous Fuels





Uniform Continuous Heavy Fuels





# Categories of Fuels

## Light fuels:

**Grass, Leaves, Shrubs**

## Heavy fuels:

**Limbs, Logs, Stumps**



# Light Fuels



# Light Pine Fuels



## Moderate Forest Fuels



A photograph of a dense forest with many tall, thin, vertical tree trunks. The ground is covered with a thick layer of fallen branches, twigs, and other forest debris, which are referred to as 'heavy forest fuels'. The trees are mostly light-colored, possibly deciduous, with some darker trunks. The background is filled with more trees, creating a sense of a thick forest. The text 'Heavy Forest Fuels' is overlaid in yellow on the right side of the image.

## Heavy Forest Fuels



Small Branches and Needles  
Ignite Quickly and create  
Intense heat. There is less  
Heat and volatility when  
Individual trees ignite than  
When groups of trees ignite.

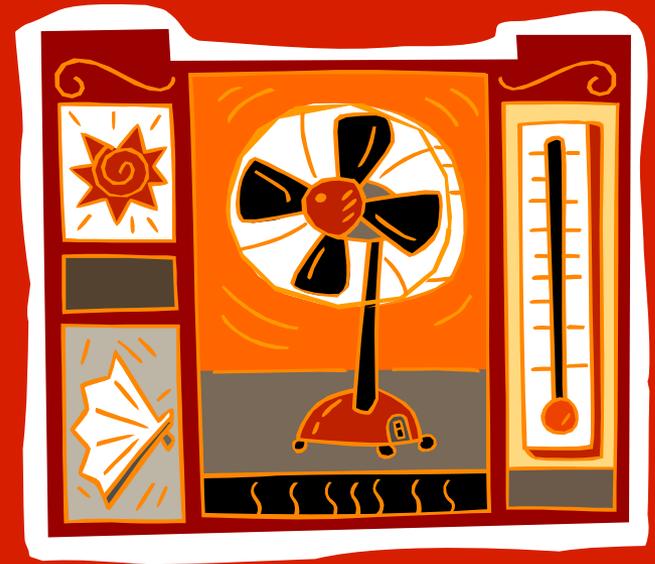


# Weather & Wildfire...

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Three fundamental parts of weather have a significant impact on wildfire:

- Temperature
- Relative Humidity
- Wind



# Weather & Wildfire...

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## Temperature:



- Preheats fuels
- Preheats the ground
- Affects air currents
- Reduces moisture in the air:
  - The higher the temperature, the lower the relative humidity

# Establishing the trigger point

## Alignment of forces

Wind - in  
Slope - in

Solar Pre-heat - hot - a.m.



## Alignment of forces

Wind - in  
Slope - out

Solar Pre-heat - hot - a.m.

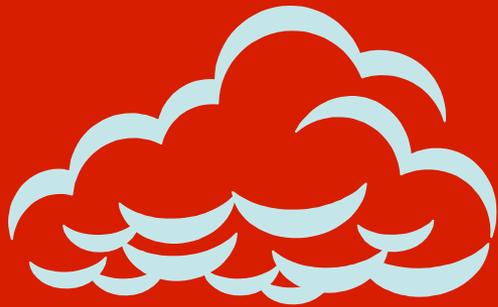


# Weather & Wildfire...

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## Relative Humidity:

- Water vapor in the air
- Hot temperature = reduced humidity
- Cool temperature = increased humidity
- Higher humidity = higher fuel moisture
- Fires usually burn more rapidly during the day due to lower humidity



# Weather & Wildfire...

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## Wind:

- Has the greatest influence on rate and direction of fire spread
- “Bends” flames close to fuel
- Generally: flows up-slope during day  
flows down-slope at night
- Variable and sometimes Unpredictable













Ladder to Crown





Needle Freeze:  
Shows wind  
direction during  
Fire.



# Topography...

**Topography = the configuration of the land**

- Topography has significant affect on RATE and DIRECTION of fire spread.
- Three fundamental parts of topography:

SLOPE

ASPECT

TERRAIN

# Topography...

## Slope

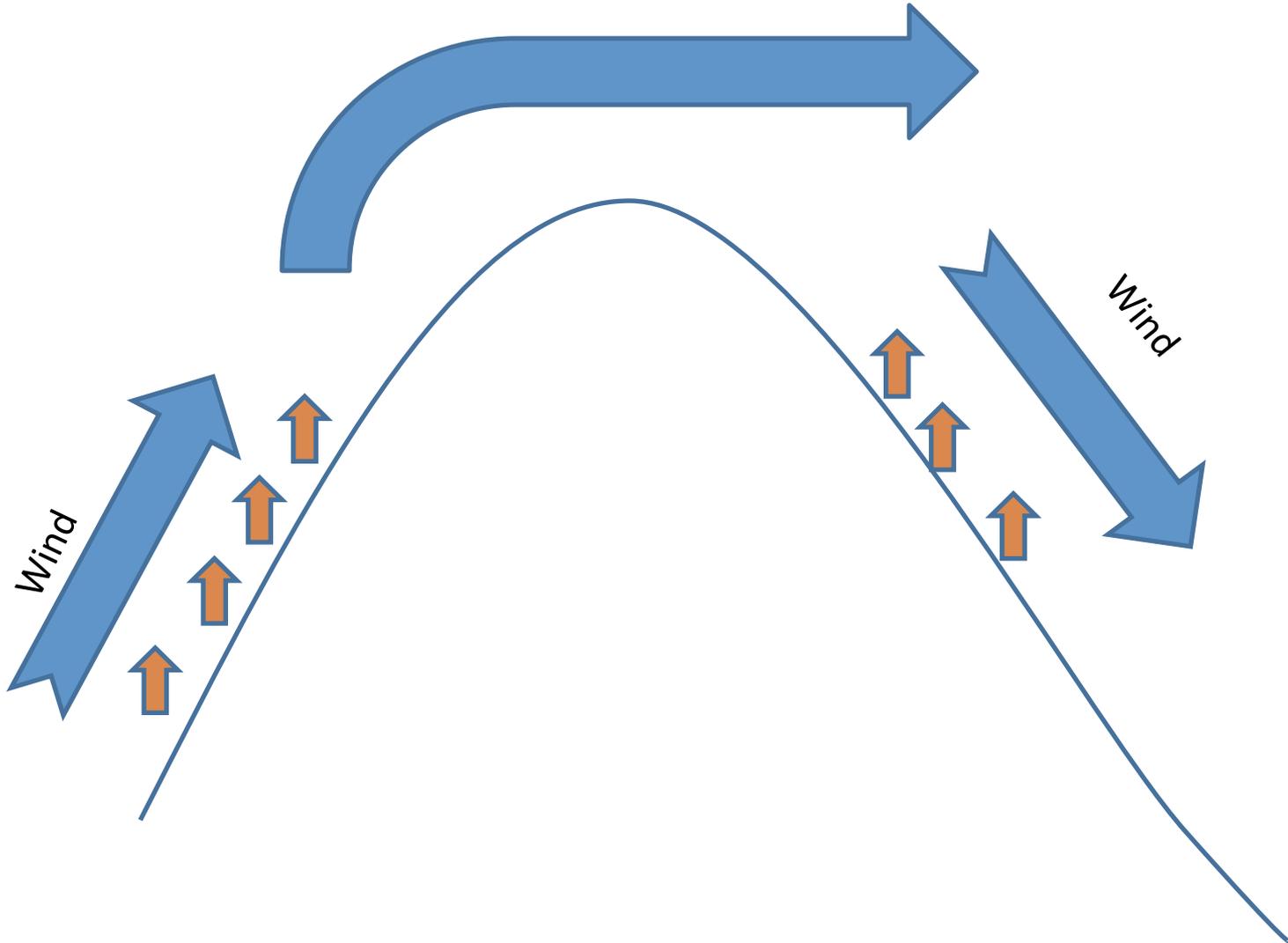


- The steeper the slope, the faster the fire will move
- Slope influences fire by preheating fuels
- Wind currents usually flow uphill
- Convected heat causes a draft
- Burning material can roll downhill



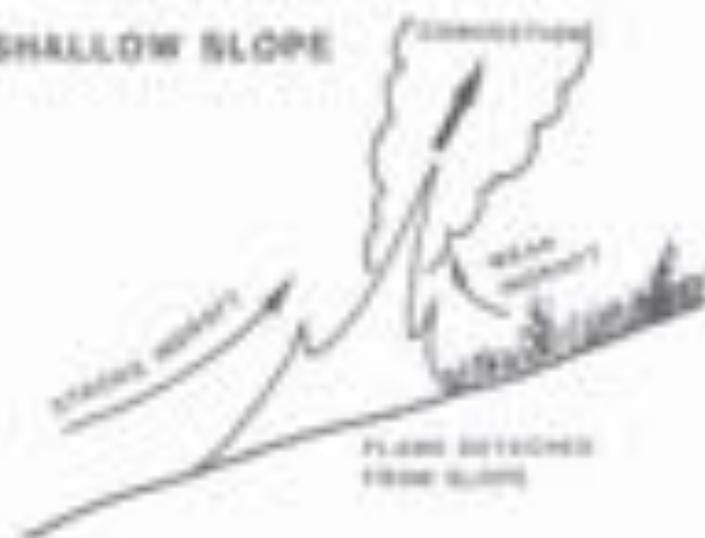
# Slope affects fire behavior







### SHALLOW SLOPE

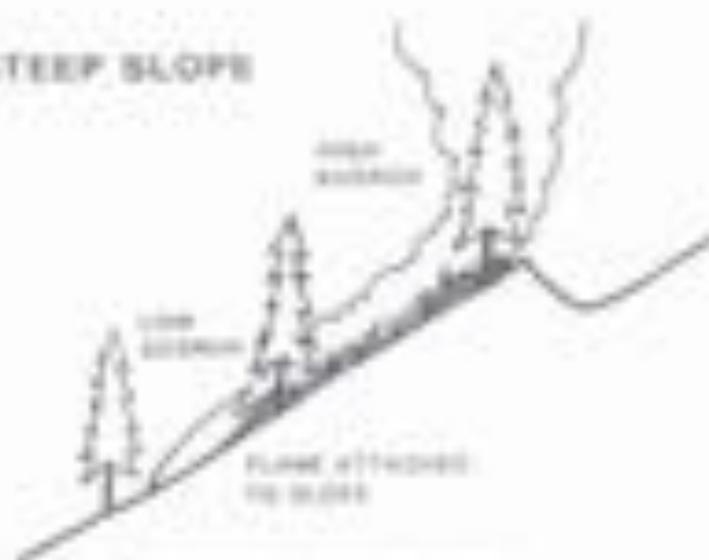


### STEEP SLOPE



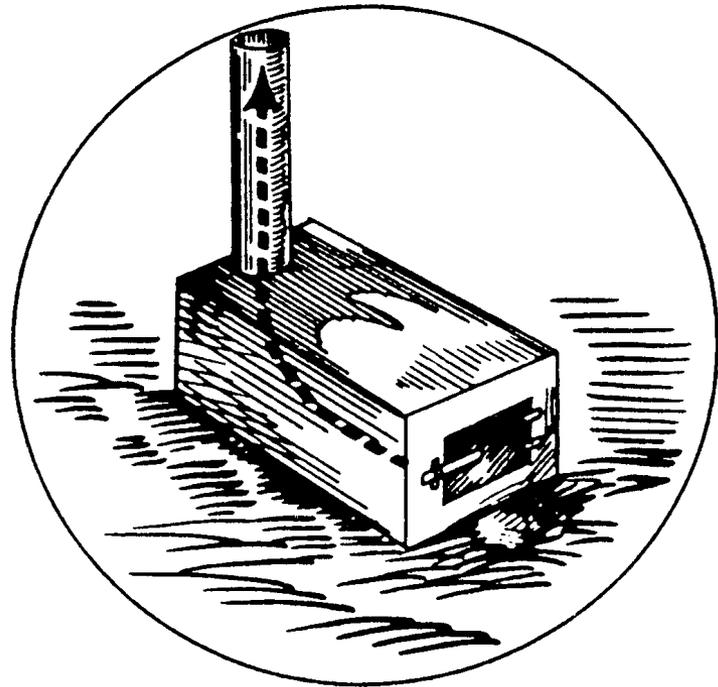
Flame attached to a shallow slope and flame detached to a steep slope

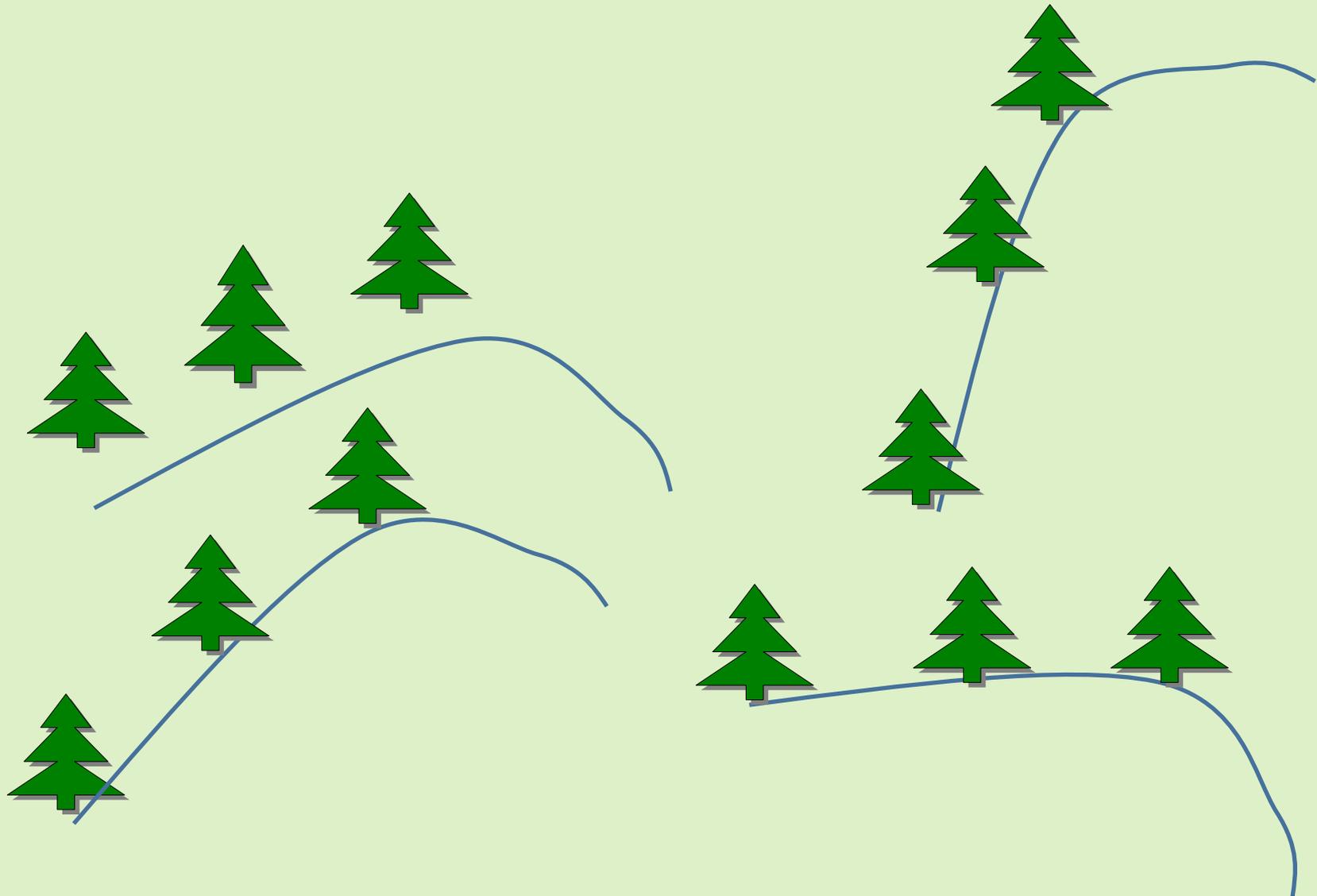
### STEEP SLOPE



Flaming conditions on a steep slope

# Box Canyon & Chimney Effect







Fatality Site

1500 to 1524h - the  
traveller an up-canyon  
run in Cachoeira Bar  
drainage, reaching H.2  
at approx. 1524h.

1500h

1500h

1720h

Cachoeira Bar

Crameter

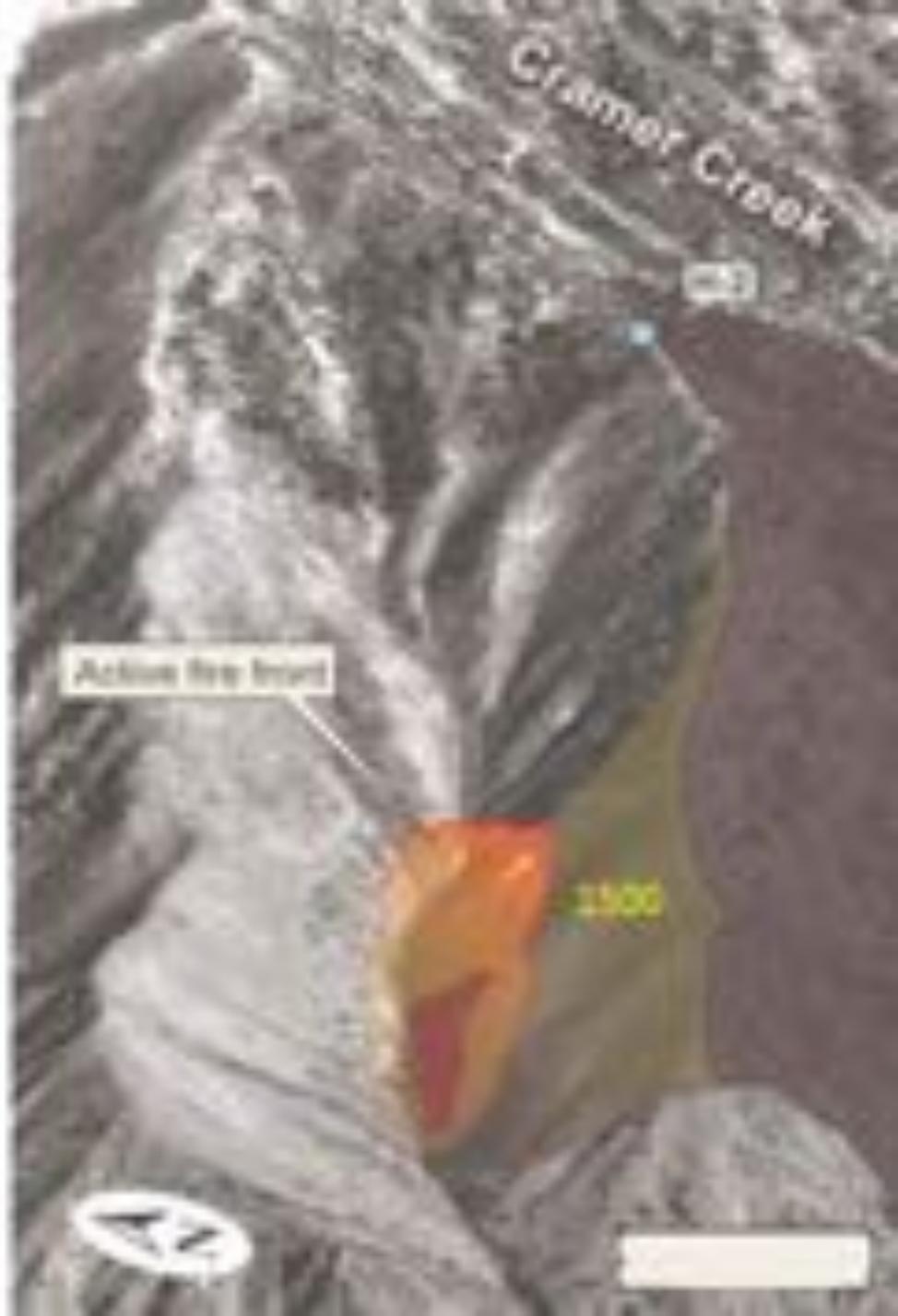
1500h

Cachoeira Bar

Cachoeira Bar







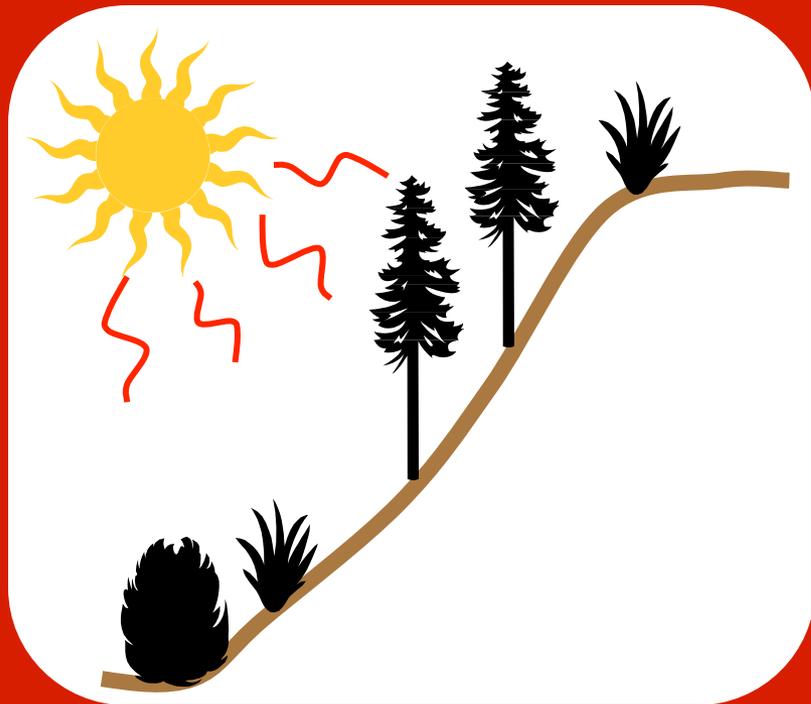






# Topography...

## Aspect



- The direction a slope faces (N, S, E, W) affects the spread of fire
- Southern aspect:
  - receives more direct radiation
  - fuels are usually drier, but less dense
  - receives a stronger slope wind

# Establishing the trigger point

Alignment of forces

Wind - in  
Slope - in

Solar Pre-heat - hot - a.m.



Alignment of forces

Wind - in  
Slope - out

Solar Pre-heat - hot - a.m.





# Topography...

## Terrain



- The “lay of the land”
- Obstructions include ridges & canyons
- Cause wind turbulence & erratic fire behavior
- Fires in canyons or steep drainages are **DANGER ZONES!**



Wind and heat are intensified when they are  
Channeled through restrictions such as saddles.





# Spot Fires: Fire Brands & Embers

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## **CONVECTION:**

Pieces of burning material are lifted into a convection column.

Embers settle on homes and vegetation far ahead of the fire-front.





**Plume from Black Forest Fire  
Near Colorado Springs**



# Spot Fires: Fire Brands & Embers

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## **WIND:**

Causes short-range spot fires ahead of fire-front.

The combination of convection & wind can carry brands considerable distances, causing long-range spotting.









**Tree Canopies offer fuel for Intense Crown Fire**





Multiple spot fires

# Summary...

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- The Elements of Fire:
  - *Fuel, Heat, and Oxygen*
- Fire Spread:
  - *Convection, Radiation, Conduction*
- Weather and Wildfire:
  - *Temperature, Humidity, and Wind*
- Topography:
  - *Slope, Aspect, and Terrain*

# Fire in the Wildland/Urban Interface



As More Homes are added to the Landscape  
Fuels Management becomes more complicated



# How Do We Define the WUI?

**Interface** WUI - "where houses meet"



**Intermix** WUI - "where houses mingle"





Example of WUI

WUI





# Beware & Prepare

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Defensible Space & Zones

The “Small Things”



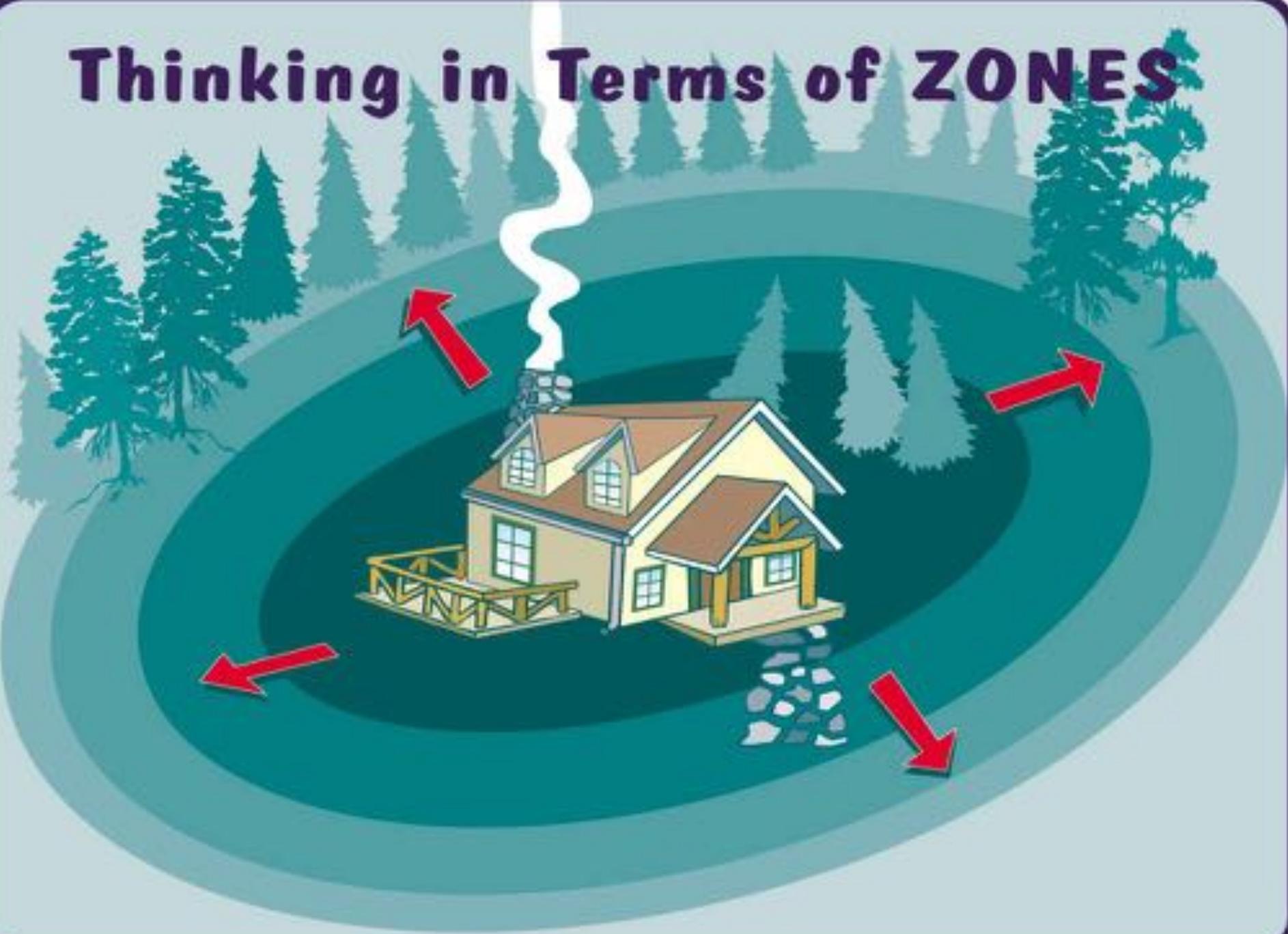
# Defensible Space

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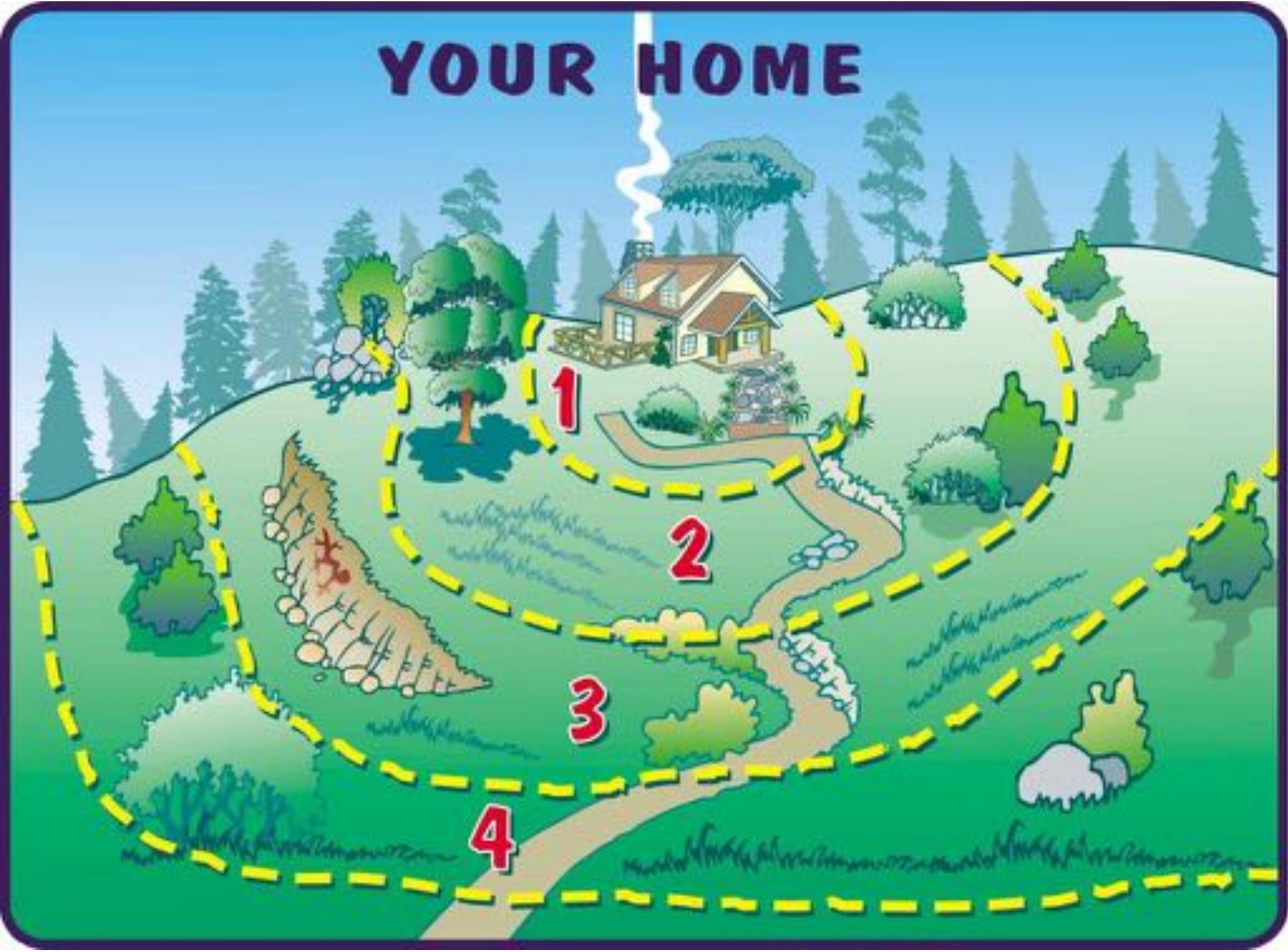
An area surrounding structures that allows firefighters and equipment the space to defend against an approaching wildfire.



# Thinking in Terms of ZONES

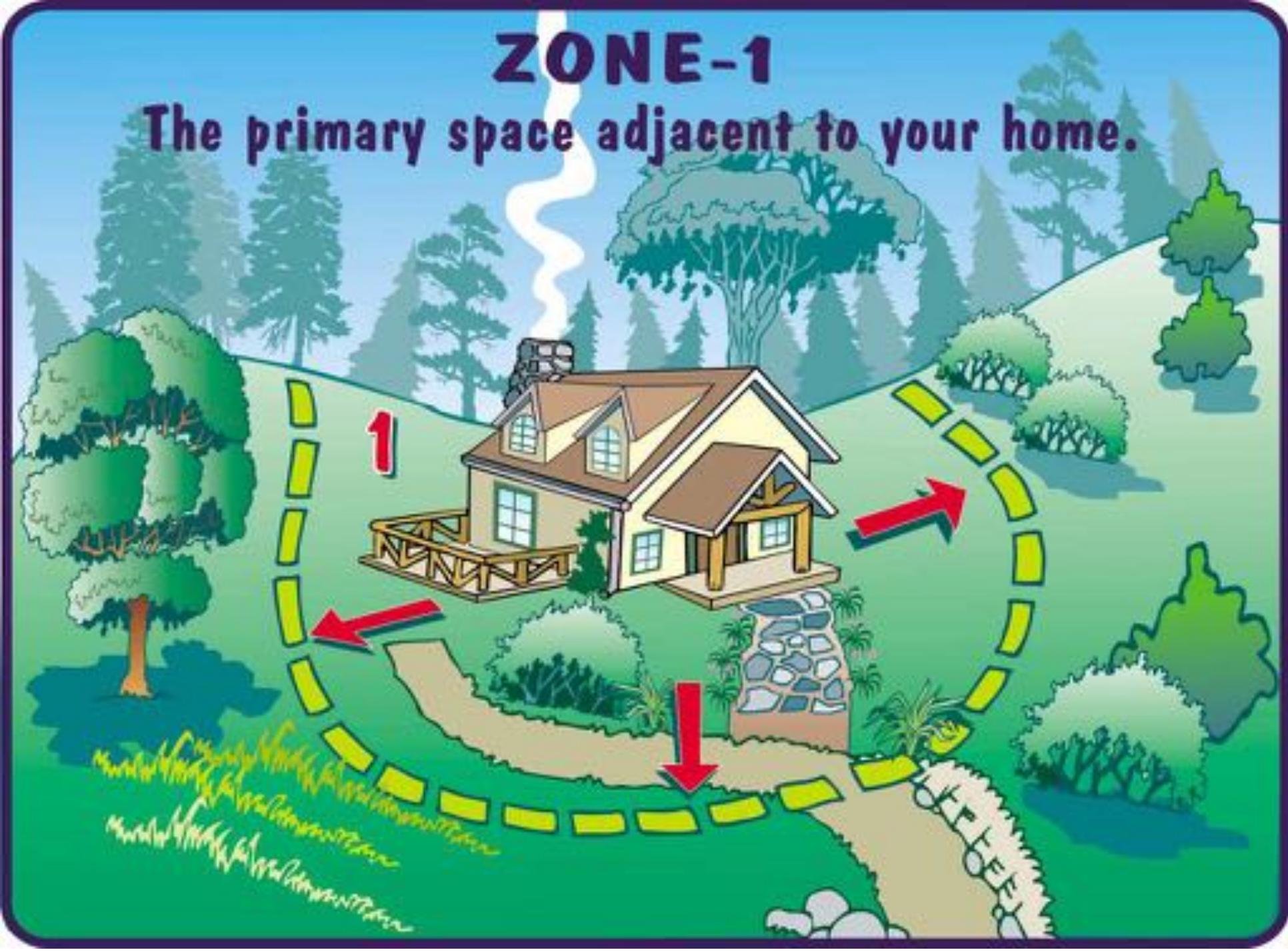


# YOUR HOME



# ZONE-1

The primary space adjacent to your home.





Firefighters were able to save this home during the 2010 Weber fire due to A good defensible space.

House is at high risk of burning during a fire due to lack of Defensible space.

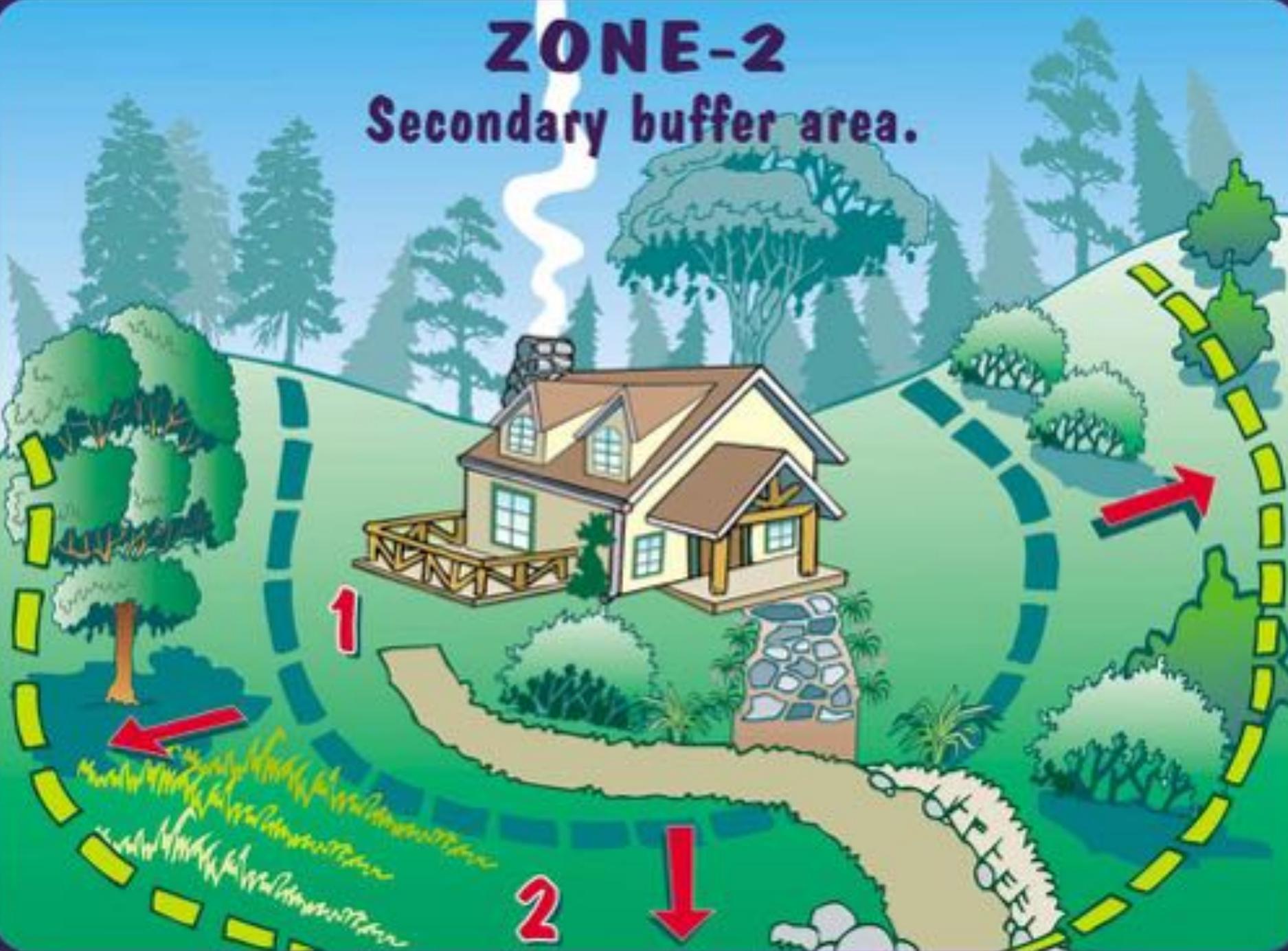






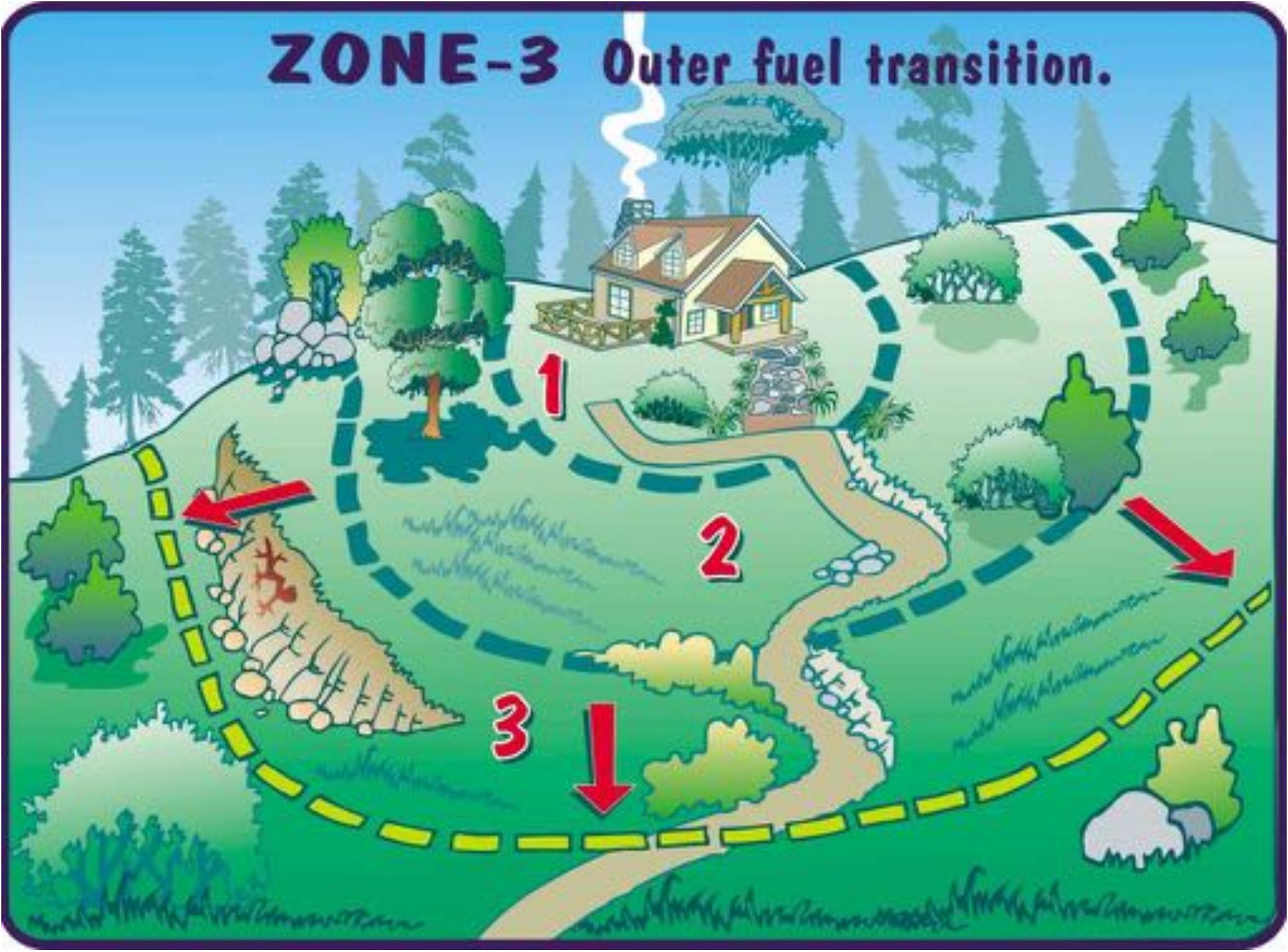
# ZONE-2

Secondary buffer area.





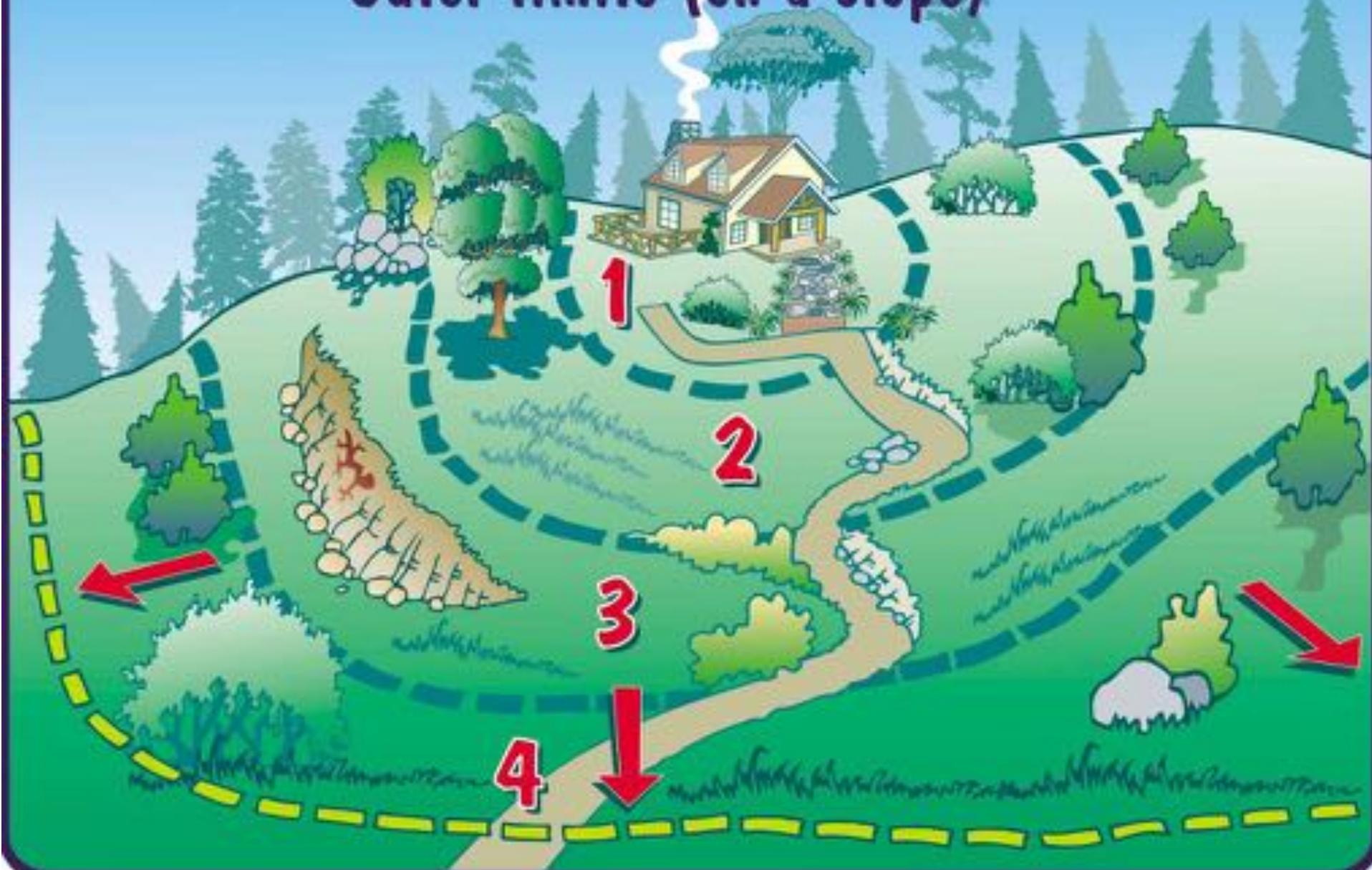
# ZONE-3 Outer fuel transition.





# ZONE-4

Outer limits (on a slope)









# MINIMUM HORIZONTAL CLEARANCE

SHRUBS



FLAT TO MILD SLOPE (<math>\leq 20\%</math>)

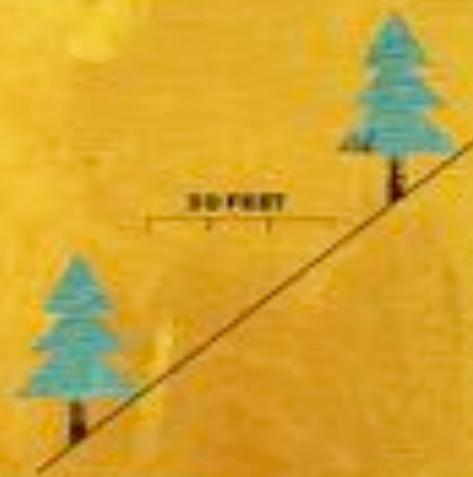
TREES



MILD TO MODERATE SLOPE (<math>20\% - 40\%</math>)



MODERATE TO STEEP SLOPE (<math>> 40\%</math>)



# The "Small Things"

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# YOUR HOME



CHIMNEY

ROOF

GUTTERS

SIDING

WINDOW

DECK



**92 Homes Lost in the Black Forest Fire near Colorado Springs**

# IT'S THE SMALL THINGS



CAULKING,  
WINDOWS  
& VENTS

DECORATIVE  
WOOD WORK

WIRE  
SCREENS

GUTTERS &  
DOWNSPOUTS



# IT'S THE SMALL THINGS



SPACE BETWEEN  
SIDING &  
EAVES GABLES

VENTS &  
SCREENS

WINDOW  
BOXES

SPACKLE  
AROUND  
WINDOW

CELLAR WELLS  
& VENTS

Wallow Fire, Alpine AZ  
1 house burned, entire  
Town had been treated.



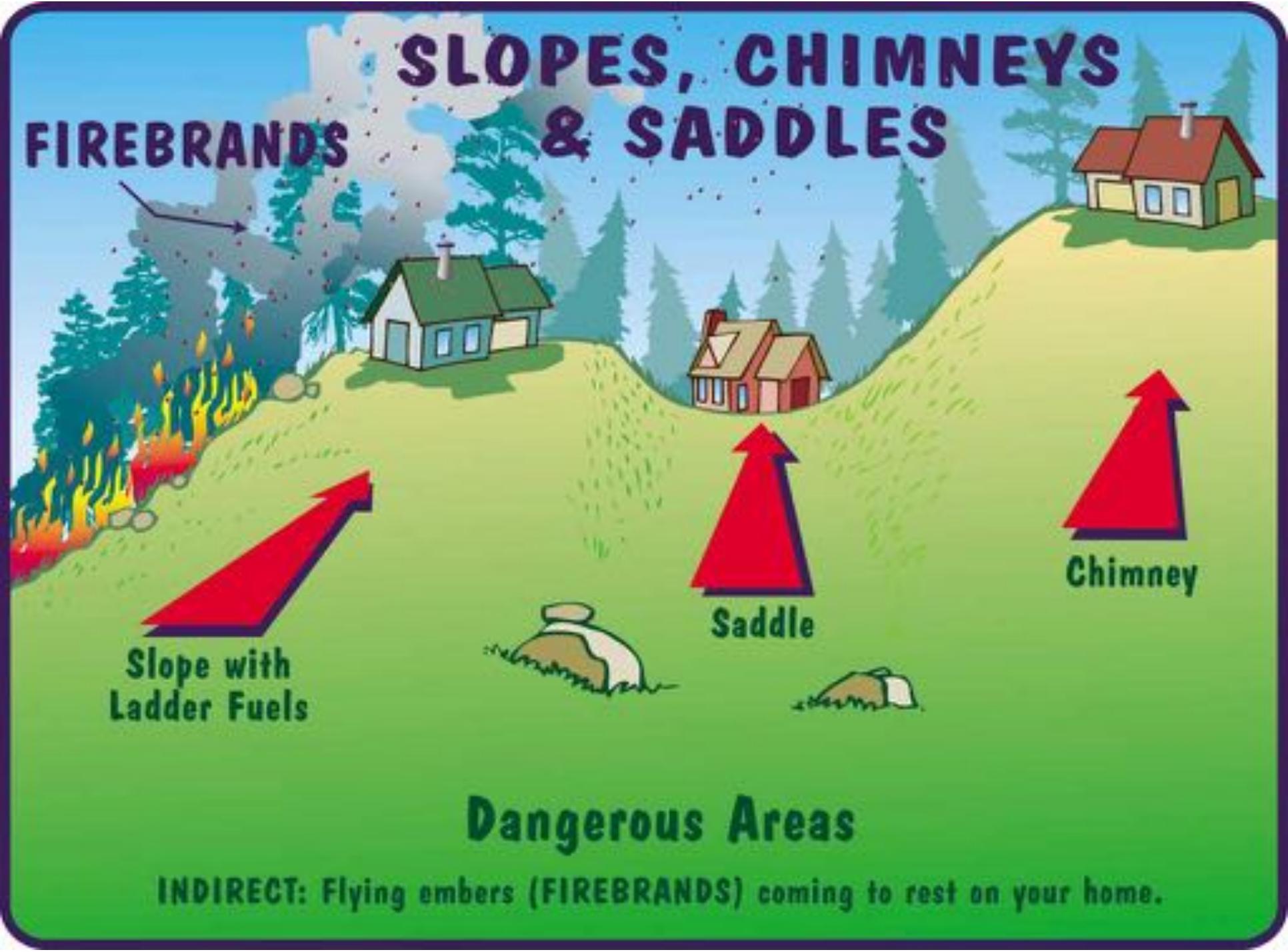


Waldo Canyon Fire moves into Subdivision:  
Note Fuels adjacent to homes.



# SLOPES, CHIMNEYS & SADDLES

**FIREBRANDS**



**Slope with Ladder Fuels**

**Saddle**

**Chimney**

## **Dangerous Areas**

**INDIRECT: Flying embers (FIREBRANDS) coming to rest on your home.**



4-3-2011

"White Fire" Ruidoso Downs, NM





Waldo Canyon Fire 2012  
Colorado Springs



# Access...

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Fire department access is extremely important & often overlooked



- Driveways and other access roads must meet or exceed your fire department's needs.
- Display address with 4" high numerals (Min) on a contrasting background.

# PROPERTY IDENTIFICATION



MAIN  
WEST

WATER

WATER

831  
WEST

831

ACCESS

ACCESS

# Access...

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- Keep roadways free from overhanging vegetation, fence posts or signage.
- “Vertical Clearance”
- Driveway/road surface and weight requirements.



# Access...

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- *Minimum* 16-foot wide driveway/access road is needed.
- May need a wider road if a number of homes are served – allowing for two way traffic (access & egress).

# Special Considerations

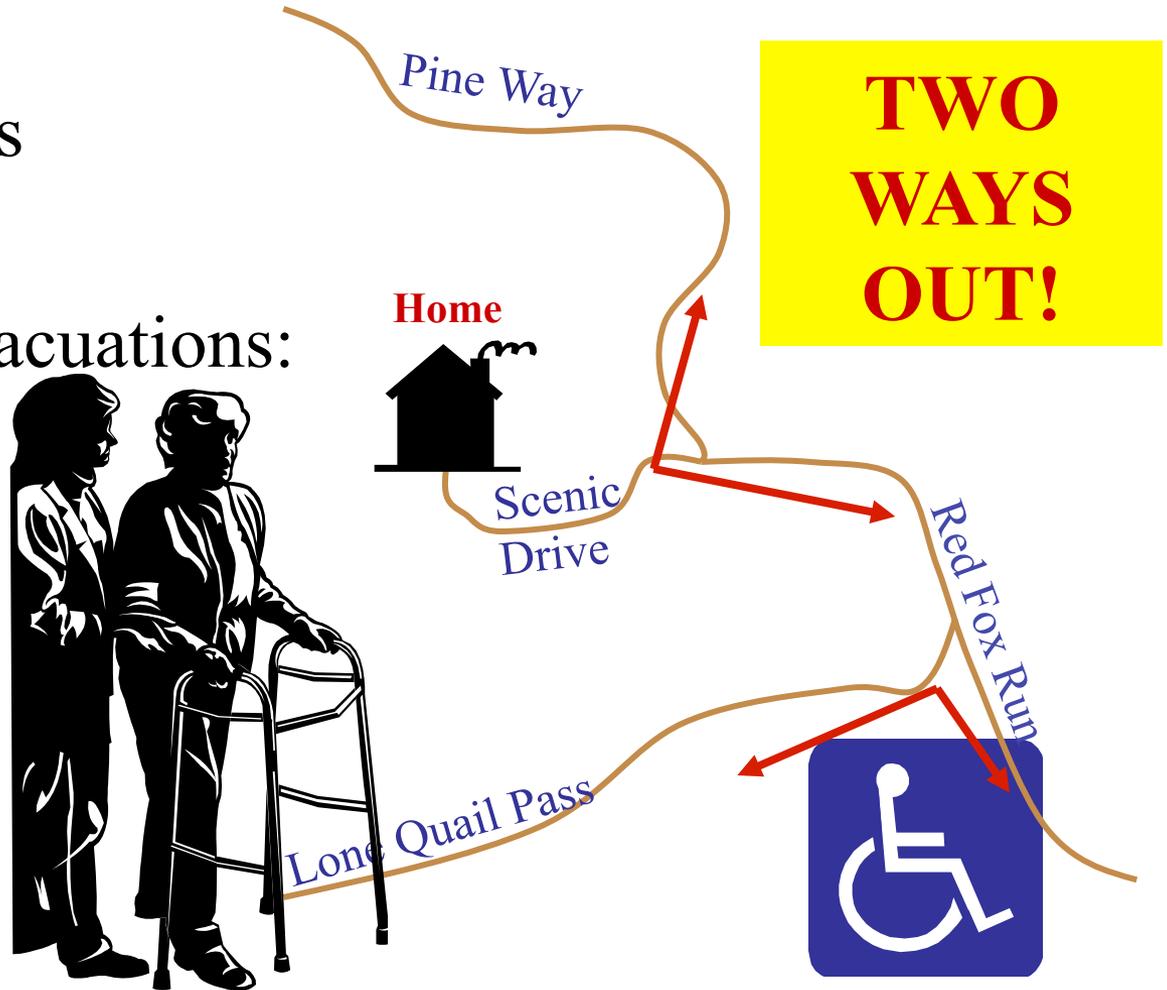
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- Evacuation routes



# Special Considerations

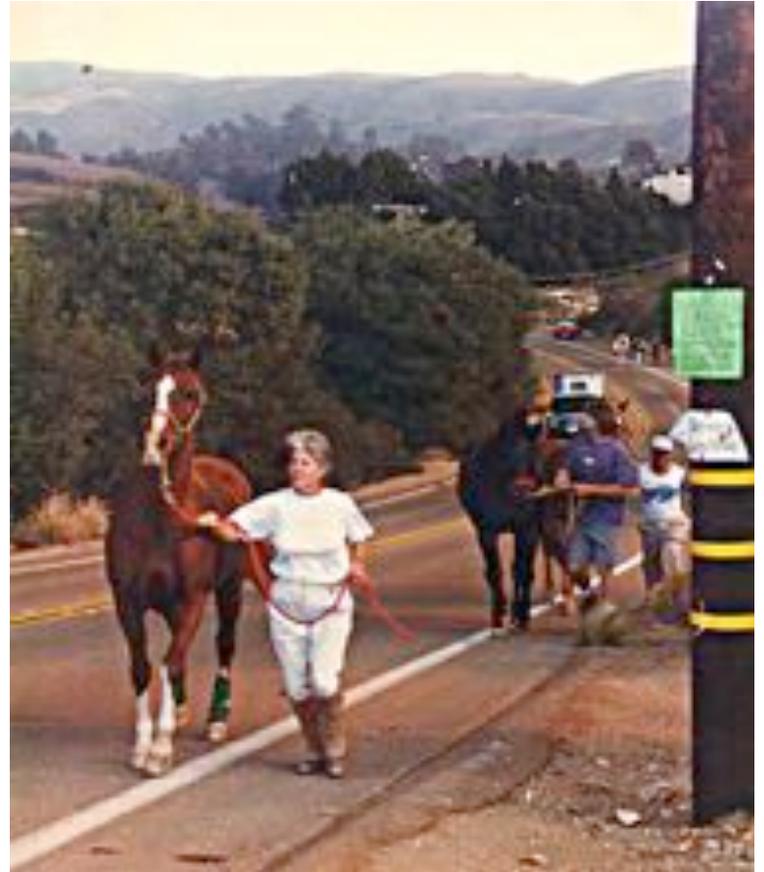
- Evacuation routes
- Special-needs evacuations:  
Plan ahead!



# Special Considerations

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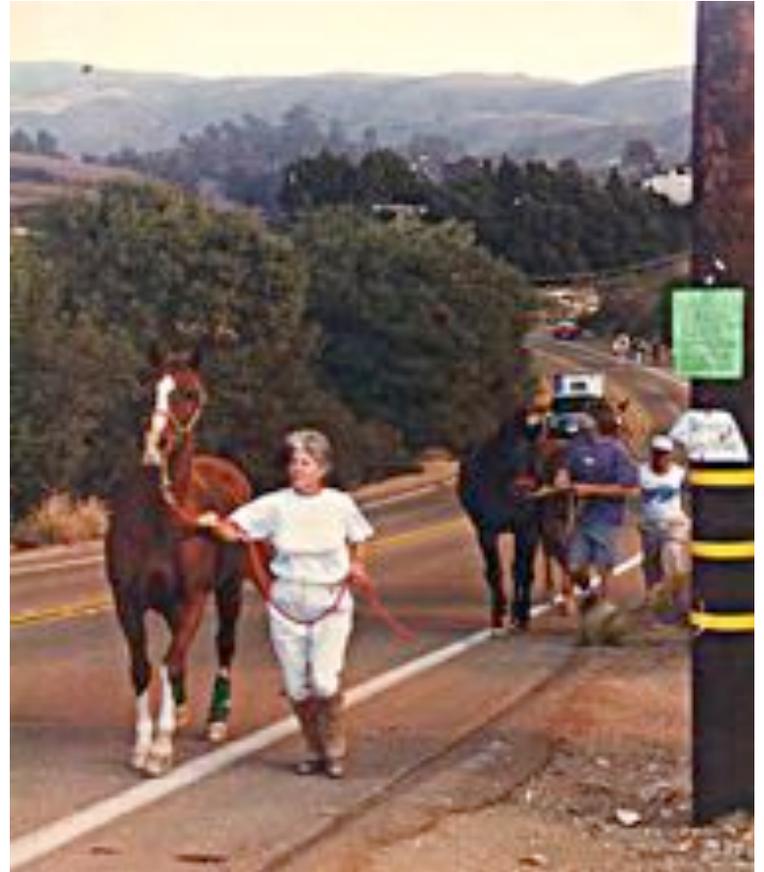
- Evacuation routes
- Special-needs evacuations:  
Plan Ahead!
- Livestock & pet evacuations



# Special Considerations

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- Evacuation routes
- Special-needs evacuations  
Plan Ahead!
- Livestock & pet evacuations
- “Safe” areas



# Summary

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## Wildfires are a year-round threat to communities throughout New Mexico

To prepare for the impacts of wildfires, continue to:

- Identify your local wildland fire problem,
- Monitor your local wildland environment,
- Reduce the fuels in your neighborhood consistent with expected fire behavior and topography.
- Create a vegetative fuels strategy to keep fire on the ground.
- Make your home defensible against wildfire,
- Plan for any special considerations for evacuating your neighborhood



Swallow  
Fire

FUELS  
MANAGEMENT



**Motel**

**Ladder Fuels**

Fire Started Here

**SLOPE STEEPENING**

**Chimney Canyon**

# Blow Out

Fire came up this way  
Torched and burned 5 houses  
On both sides of the draw.

# Chimney Canyon

**Motel**



**Fire Started Here**

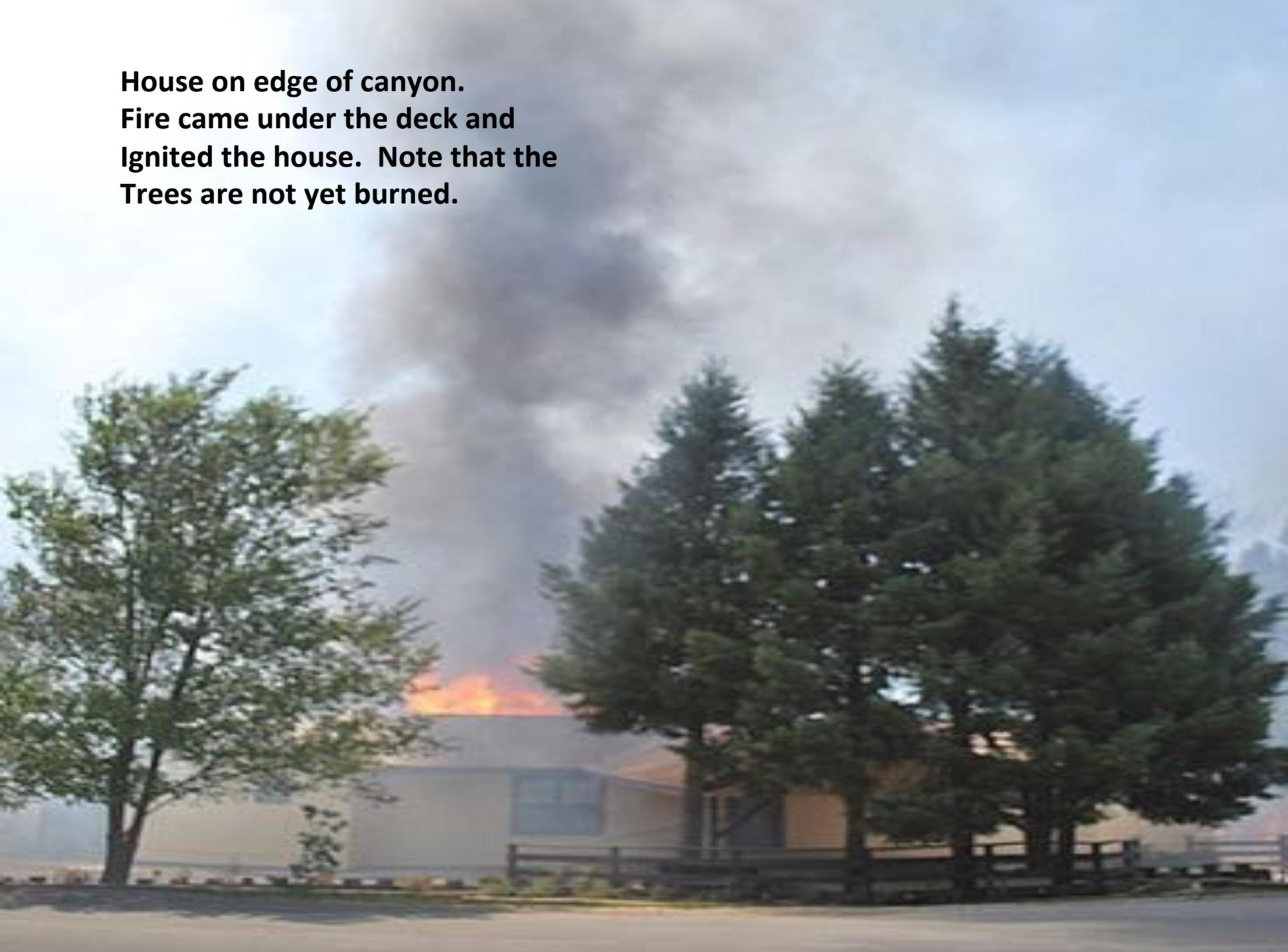
**Came out under  
wooden decks**

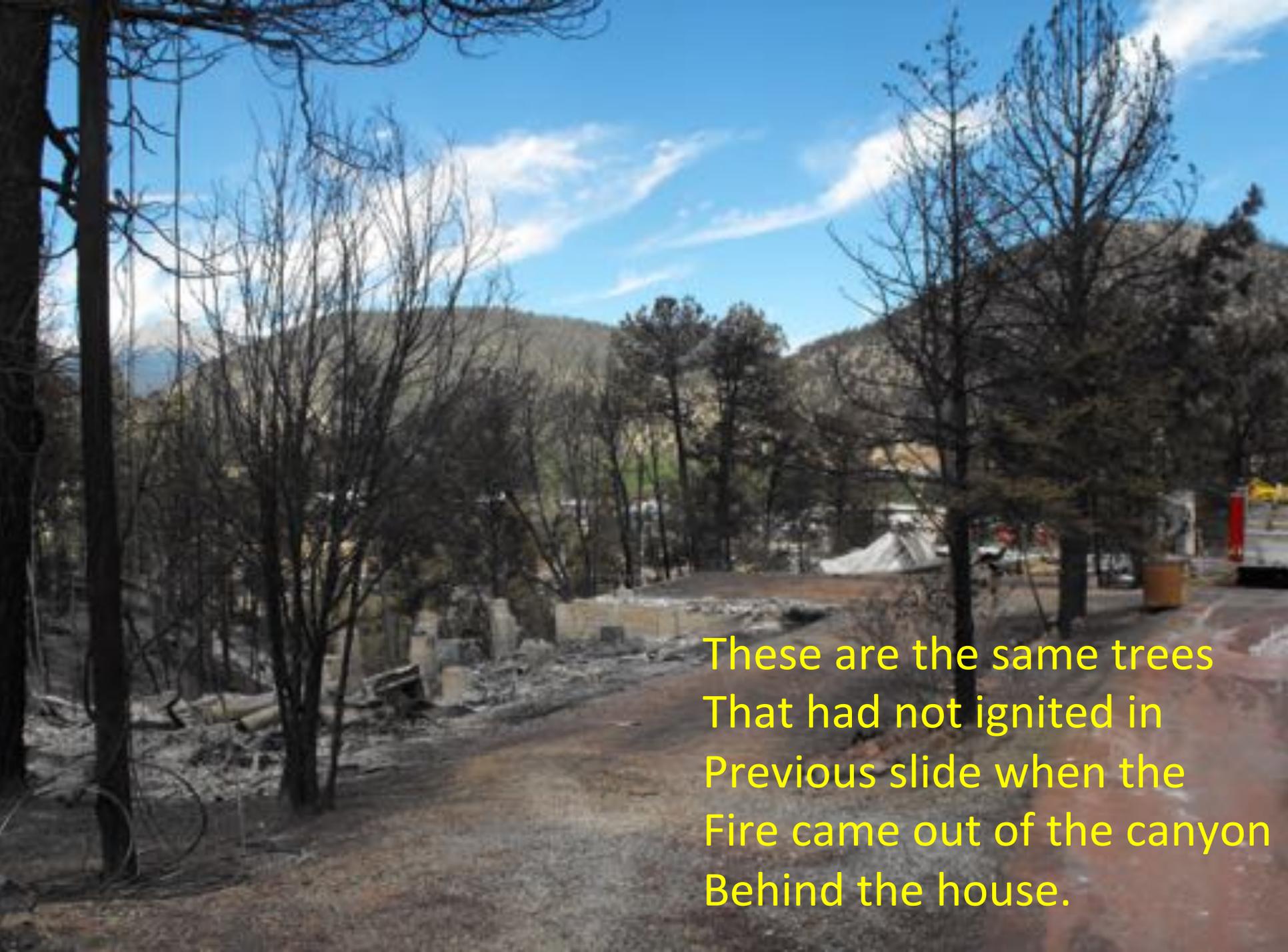


A photograph showing a canyon with charred trees and destroyed houses on both sides. The scene is dark and desolate, with many trees reduced to black, skeletal remains. In the background, a white vehicle is visible on a road. The ground is covered in ash and charred debris.

**Burned Houses  
Both sides of  
canyon**

**House on edge of canyon.  
Fire came under the deck and  
Ignited the house. Note that the  
Trees are not yet burned.**





These are the same trees  
That had not ignited in  
Previous slide when the  
Fire came out of the canyon  
Behind the house.



**Another of the houses  
That ignited when the Fire  
Came out of the Canyon.**





**House across the street from the previous slide. This house caught fire from a wood pile and Wooden fence behind the house. Note that the House burned the trees.**

Wood Rack



# Wood Rack



All of the trees burned here were the result of the house..  
Vegetation was trimmed so grass burning did not burn the  
Trees. Note that grass under burned but did not burn trees.



Trimmed Trees

NO Ladder

Underburned

Ladder Fuel



Trimmed Tree

Underburned





**No Ladder**

**Underburned**

**Slurry**

# Defensible Space

Trimmed Trees

No Fuel on Ground

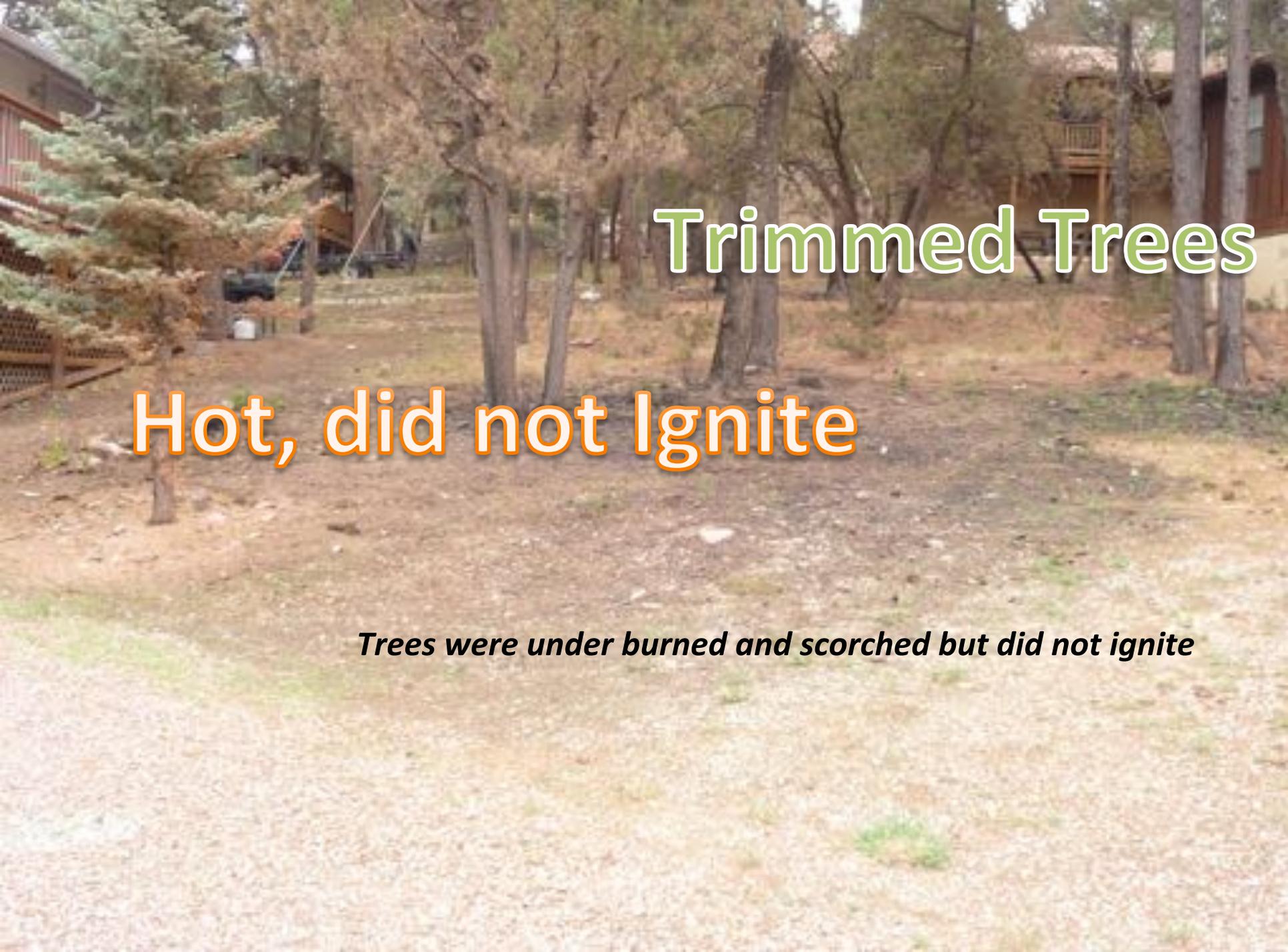




**Canopy did not Burn**

**No Ladder**

**Underburn**



Trimmed Trees

Hot, did not Ignite

*Trees were under burned and scorched but did not ignite*



**Defensible Space**

**Trimmed Trees**

**Slurry got to ground**



**Trailer Burned due  
To Firebrand. Trimmed trees  
Did not ignite.**

**House ignited, burned trees**



# The House Burned The Trees

**Grass carried ground fire to the  
Back or the house where it ignited  
A wooden fence and/or firewood that  
Burned the house.**



**Retardant is only effective when it gets to the ground.  
Thinning allowed this seat plane to do its job.**

**SEAT Plane**



A photograph showing a thinned tree stand. The ground is covered with a layer of brown mulch or slurry, which has been applied to the ground between the trees. In the background, two cars are parked on a paved area. The text is overlaid on the image in a bold, red font with a black outline.

**Thinned Trees**  
**Allowed Slurry to hit ground thus**  
**Slowing or preventing the spread of the**  
**Ground fire.**

# Defensible Space

## Trimmed Trees

Fire got to here  
And stopped.





**Very Lucky**

**Move wood away from structure  
During dry season**



# Powder Keg





**Good JOB !!!**

**Defensible space with firewood  
Away from structure.**