



Answers from the Ashes

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ADVANCED ENGINEERING INVESTIGATIONS CORPORATION

Learning Objectives

- Determine the general, specific and exact points of origin of wildfires utilizing established scientific methodology and current investigative techniques.
- Understand Community Planning as it relates to wildfires
- Concepts in the IWUI Code & NFPA 1144

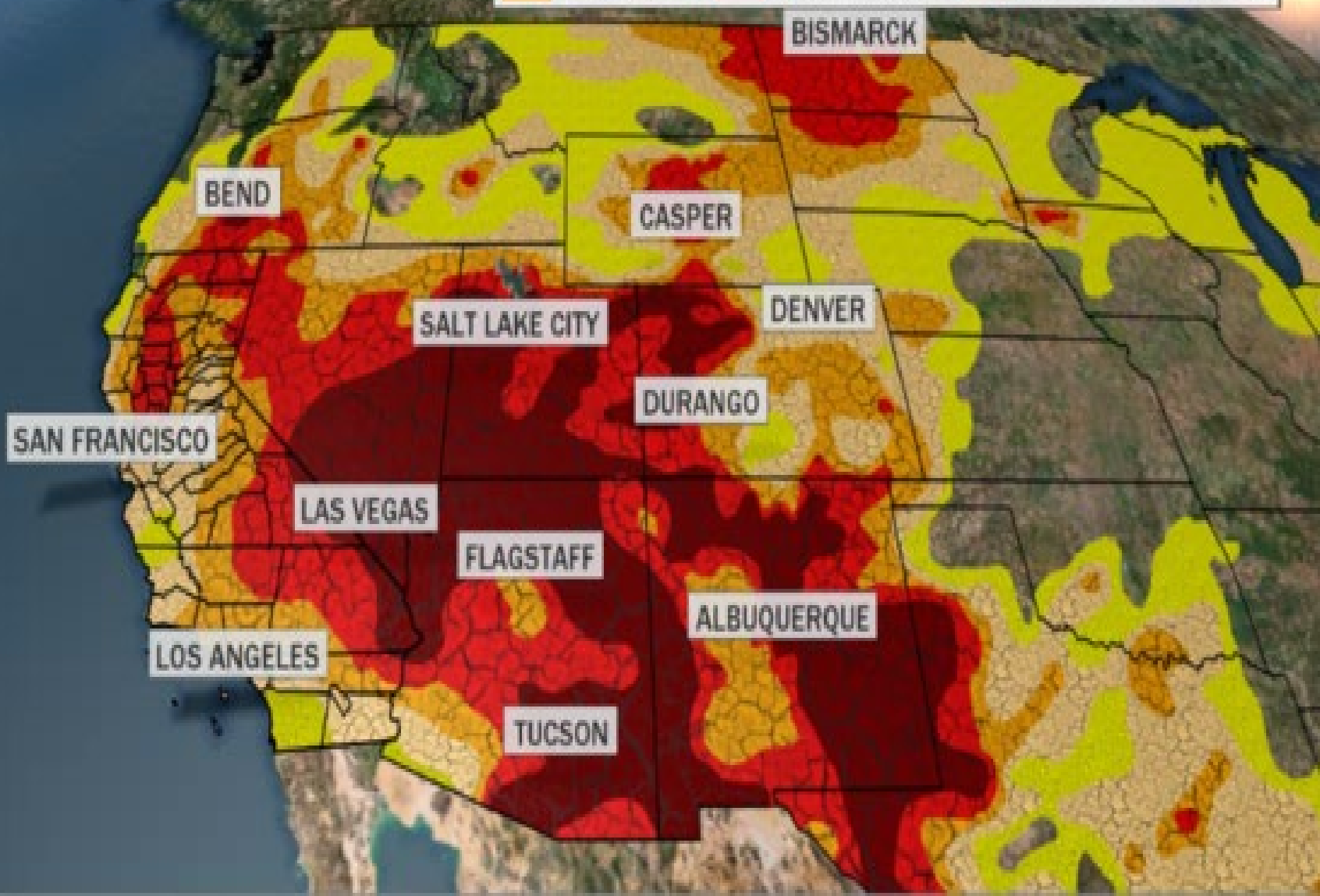
Putting Together The Pieces of the Puzzle





RELENTLESS DROUGHT

SEVERE EXTREME EXCEPTIONAL



Annual impacts to all of us!

Direct losses – infrastructure

Suppression – in 2021 over \$4.4 billion

Total damage & accumulated costs ~\$70 to 90 billion

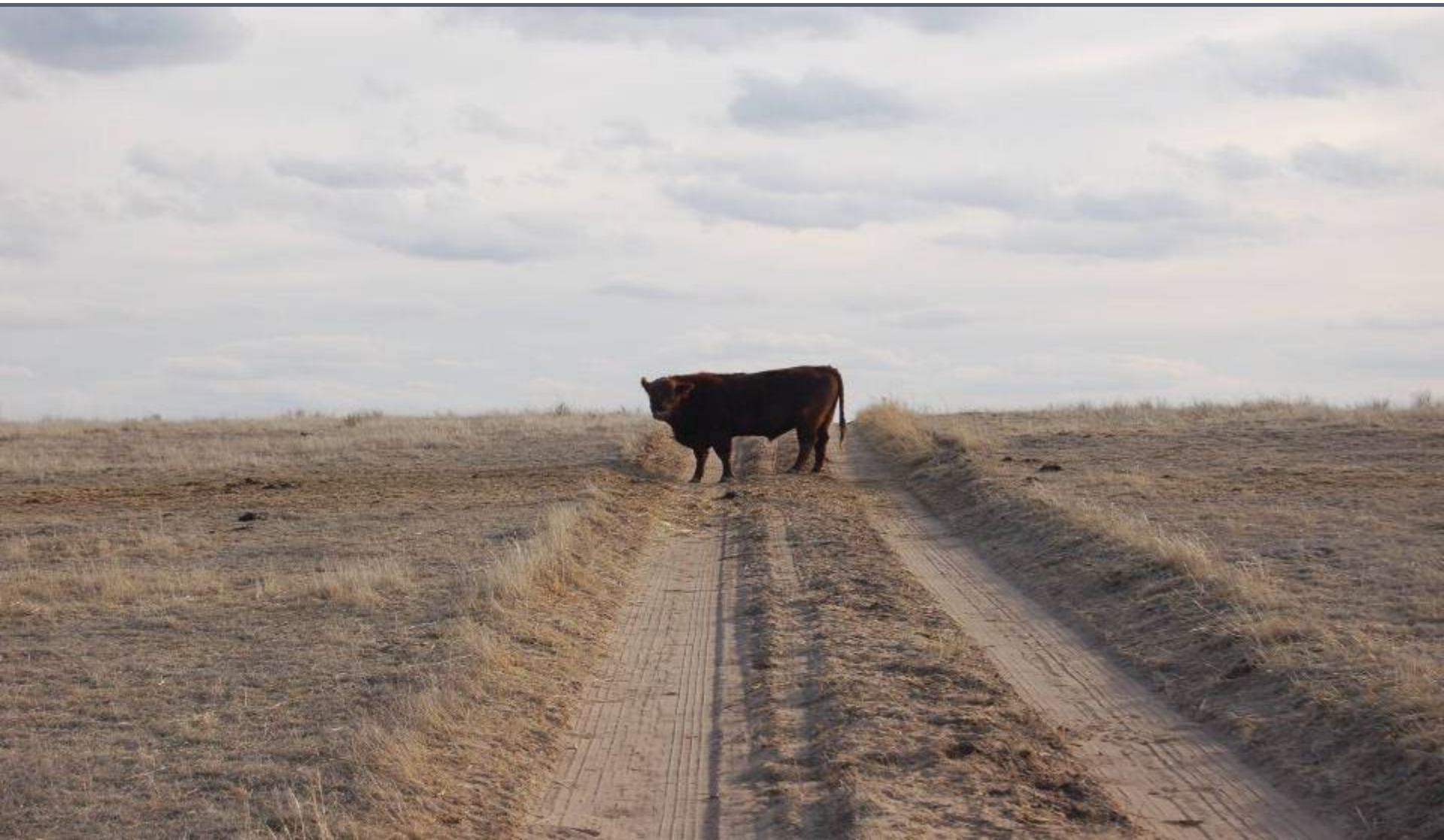
~7 to 10 million acres lost annually

Timber/agriculture loss....Tourism/economic loss

50,000 to 70,000 reported wildfires annually



Obstructions



~85% of Wildfires are Human Caused

- Equipment
- Machinery
- Fireworks
- Juveniles
- Utilities
- Campfires
- Stupidity!!!!
- Arson



The Interface Zone – Growing Exponentially in the World



Fire Spread

- Driven primarily by Wind
- Second influence = topography
- Final influence = Fuel Package



Weather Factors

- Chinook winds
- Santa Ana winds
- Upslope & down slope winds in canyons
- Thunderstorms
- Plume dominated fires
- Temperature inversions
- Flying embers at lower & upper levels



Wind Driven Fire



Terrain & Wind Driven Fire



1. 28. 1999

Church's Park Fire 2010



12:48:47



12:57:44



12:59:36



1:03:43



1:04:30



1:04:51



1:05:06



1:09:24

Beetle Kill Trees = Exponential Growth



Plume Dominated Fire









FIRE WEATHER



ADVANCED
ENGINEERING
INVESTIGATIONS
CORPORATION

What You Need To Know

Where do you find Fire Weather Info?

- Current
- Past



STRIKEnet Report

Report Title:

Total Lightning Strokes Detected: 1336

Lightning Strokes Detected within 10 mi/16 km radius: 1080

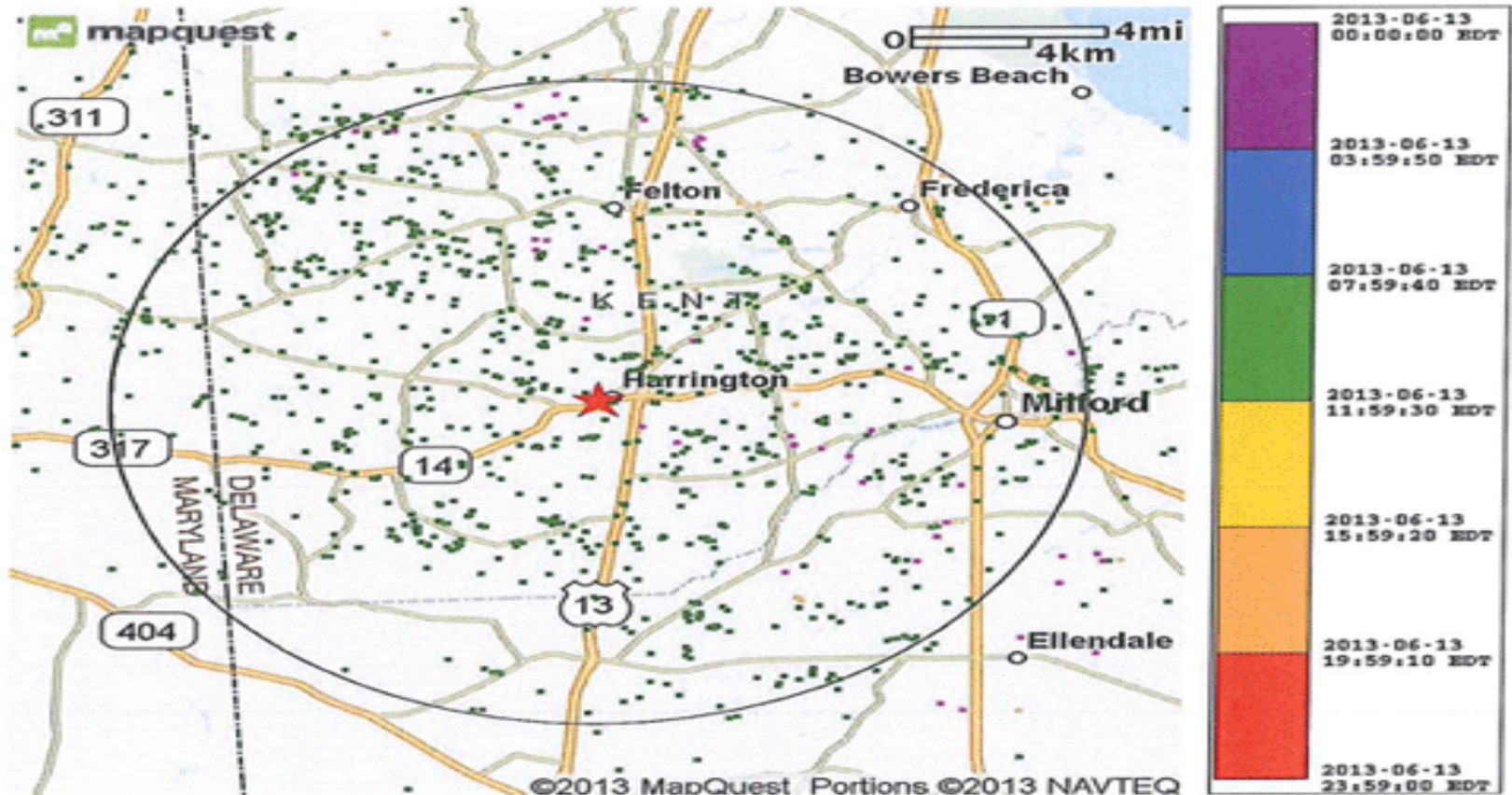
Lightning Strokes Detected beyond 10 mi/16 km whose confidence ellipse overlaps the radius: 256

Search Radius: 10 mi/16 km

Time Span: Jun 13, 2013 12:00:00 AM US/Eastern to

Jun 13, 2013 11:59:00 PM US/Eastern

Location Points For Lightning Strokes



WILDFIRES VS STRUCTURAL

- WILDFIRES Are Different than Structural
- Most to least damage, Char Depth, Fire Cause Classification, Spoliation, Specific Training
- Wildfire Terminology
- Wildfire Equipment
- Wildfire Evidence Collection
- Wildfire Location
- Jurisdiction - Private vs Public vs Federal. Have to Know!



NFPA 921, 2021 Edition

- NFPA 921 (2021) Chapter 27
- Section 27.1 Introduction. Wildfire investigation involves specialized techniques, practices, equipment, and terminology. While the basic principles of fire science and dynamics are the same in a wildfire, the fire development and spread is influenced by different factors such as wildland fuels, fire weather, topography, and unconfined burning



NFPA 1033

- NFPA 1033 Standard for Professional Qualifications for Fire Investigator
- The fire investigator is expected to remain current on the topics listed in the general requirements section of the document by attending formal education courses, workshops, and seminars, and through professional publications and journals.



Some Definitions First

- **Advancing Fire = Associated with the head or front of the fire = intense burning, increased flame height/length. Usually macro patterns are associated with it.**
- **Backing Fire = Associated with the rear of the fire. Against the wind or down slope, near the area of origin. Micro patterns are seen.**
- **Flanking Fire = Lateral sides, burning seen on only one side of fuels**



Advancing Fire





Backing Fire



Two Areas to Examine Prior to Cause Examination

- General Origin Area
- Specific Origin Area
- **ONLY** after the General and Specific Origin Areas are identified should we begin to look for the cause

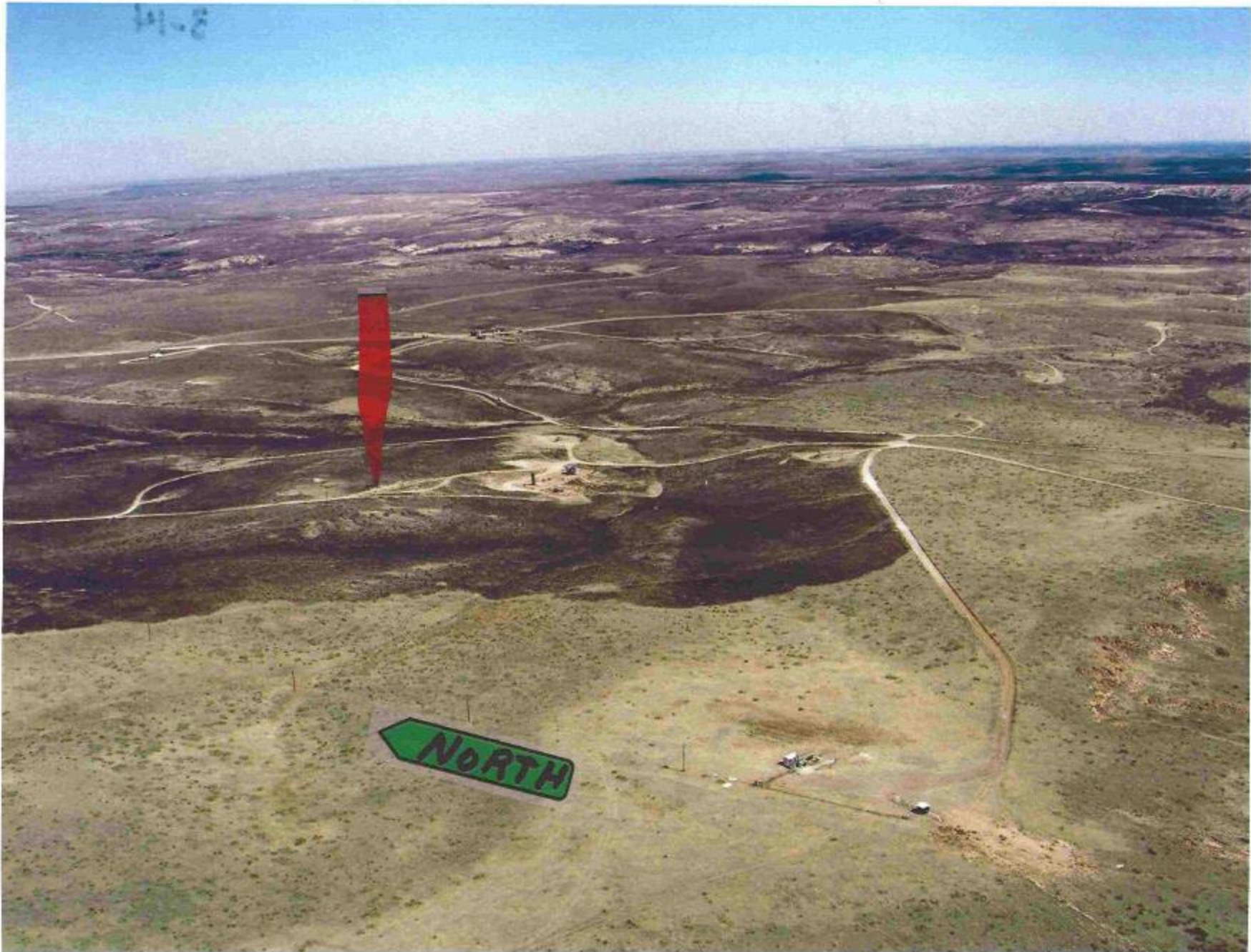


General Origin Area

- How do we narrow down a 30,000 acre fire to 1 or 2 acres?
- Look for macro indicators
- Interviews
- News footage
- YouTube



D.C.
8-14





Flagging used for a grid search

- Document all flagging on a map with established reference points
- Blue flag = backing fire
- Yellow flag = flanking fire
- Red flag = advancing fire
- White flag = point of origin or evidence

Specific Origin Area (SOA)

- Use both macro and micro indicators to establish a SOA
- SOA is often a tenth of an acre or less
- Once we see advancing patterns transition to backing patterns we are at a SOA
- Now it is time for a grid search











Common Mistakes in Wildfire Investigations- Source = NWCG

- Not applying a systematic methodology
- Not operating as a team
- Misinterpretation of burn patterns
- Not making 2 or more circuits around the perimeter of origin



Indicator Categories

- Protection
- Grass Stems
- Needle Freeze
- Sooting
- Degree of Damage
- Depth of Char
- Angle of Char
- Spalling
- Curling
- Staining
- White Ash
- Cupping
- V Patterns















Which direction
did this fire come
from?





DIRECTION OF FIRE TRAVEL

2



DIRECTION OF FIRE TRAVEL


















K&M Division JULY 04
Tulsa, OK 74103


DIRECTION OF FIRE TRAVEL





2

TOP OF TREE IN RED



9

DIRECTION OF FIRE FRONT



DIRECTION OF FIRE TRAVEL

12




DIRECTION OF FIRE TRAVEL



How good are you!



Items to be Ruled Out

- Smoking
- Campfire
- Lightning
- Debris Burning
- Incendiary (Arson)
- Equipment Use
- Railroad
- Holdover Fires
- Structures
- Children
- Power Lines
- Fireworks
- Cutting/Welding
- Firearms
- Blasting
- Glass/magnification
- Spontaneous Combustion
- DOES NEGATIVE CORPUS WORK IN WILDFIRES??







BRANCH 1
(B1)







Cigarette Ignitions

- Have decreased over 23% in the last decade – why?????
- Fine Dead Fuel Moisture must be below 14% for ignition
- 30% of glowing tip must be exposed to extremely fine fuel
- Favorable tip orientation
- Cannot start a wildfire when winds are over 17.9 mph
- Difficult ignition with ambient temperatures under 80 degrees F.



Probability of Ignition Based on RH

- Over 22% RH Not Possible
- ~18-22% RH Start Unlikely
- 10-18% RH Start Possible
- 0 -10% RH Start Likely









5

4

3

2

1

1 INCH

BUREAU OF ALCOHOL, TOBACCO AND FIREARMS

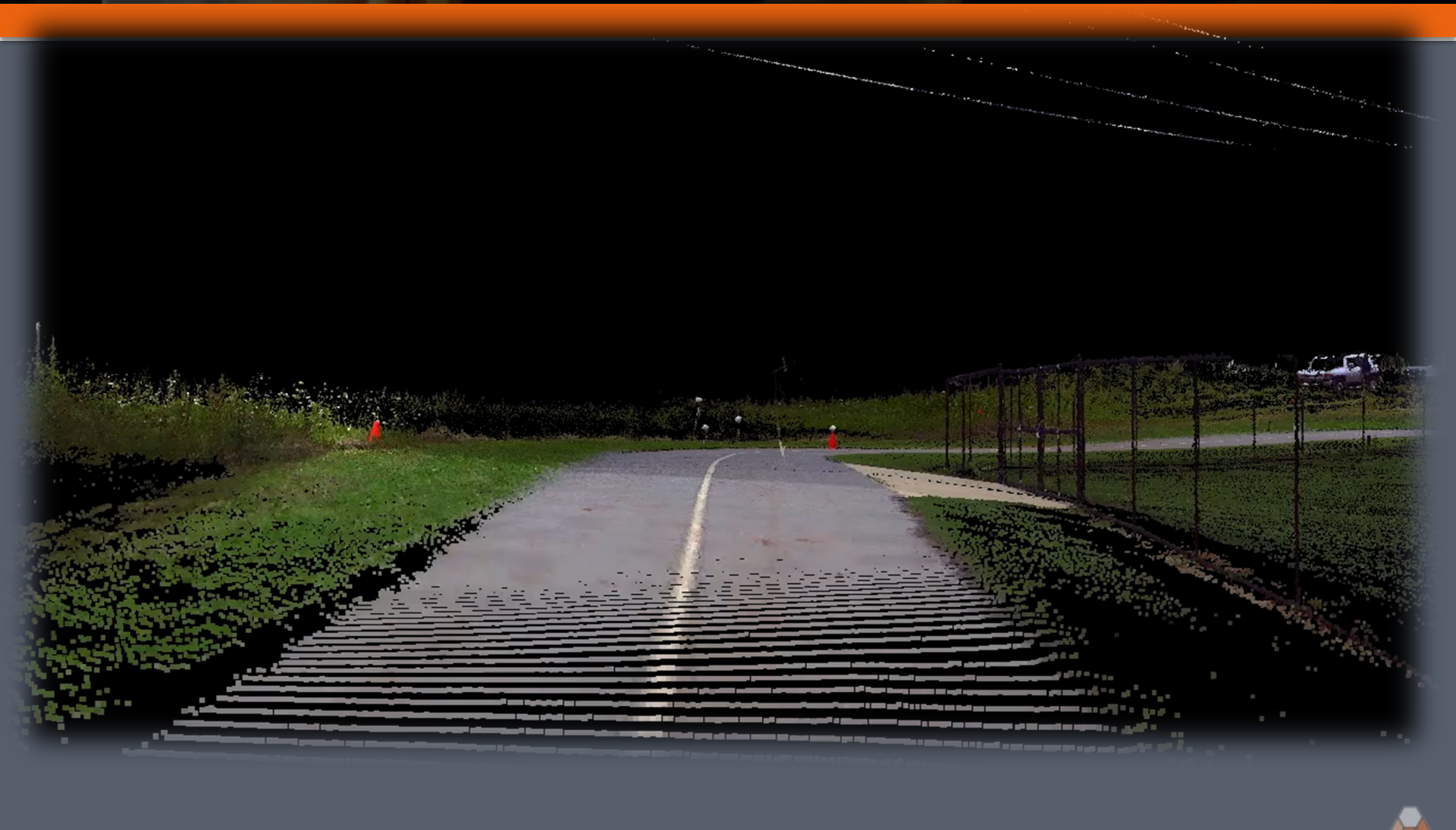
ATF

- LiDar → light detection and ranging
- Documents large losses with detail



New Documentation Techniques: LiDAR, 3D Photography & Drones





Case Study

















5639
7:20:01

Community Planning

- **Items to consider:**
- Every state in the USA has wildfires...even Hawaii!
- Insurance Companies
- Community Infrastructure/Density
- Political climate
- History of wildfires
- Current building/fire codes







FIRE DEPT

FIRE DEPT
LOW
TODAY



MINIMUM VERTICAL CLEARANCE

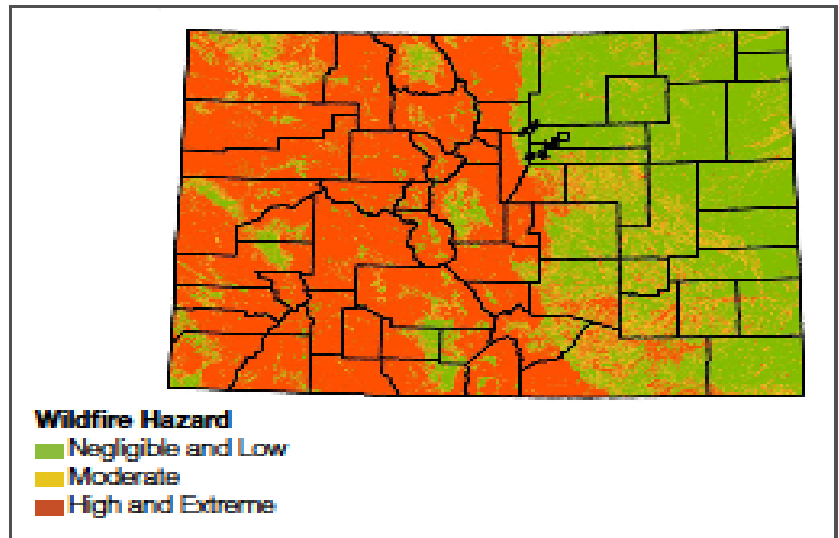


FireLine® State Risk Report—Colorado

Wildfire Risk at a Glance

Number of Housing Units ^a	2,212,900
Number and Percentage of Housing Units at High and Extreme Risk	373,900 17%
Largest Insured Wildfire Loss ^b	\$450 million (2012)
Number of Acres Burned in 2019 ^c	40,400
Largest Historical Wildfire ^d	Hayman (2002) 137,800 acres burned

Sources: 1. U.S. 2010 Census, 2. FICSP, 3. National Interagency Fire Center (NIFC)



According to U.S. Census data, Colorado has 2,212,900 housing units. The following is a breakdown of the percentage and number of housing units broken out into the low, moderate, and high wildfire risk categories.

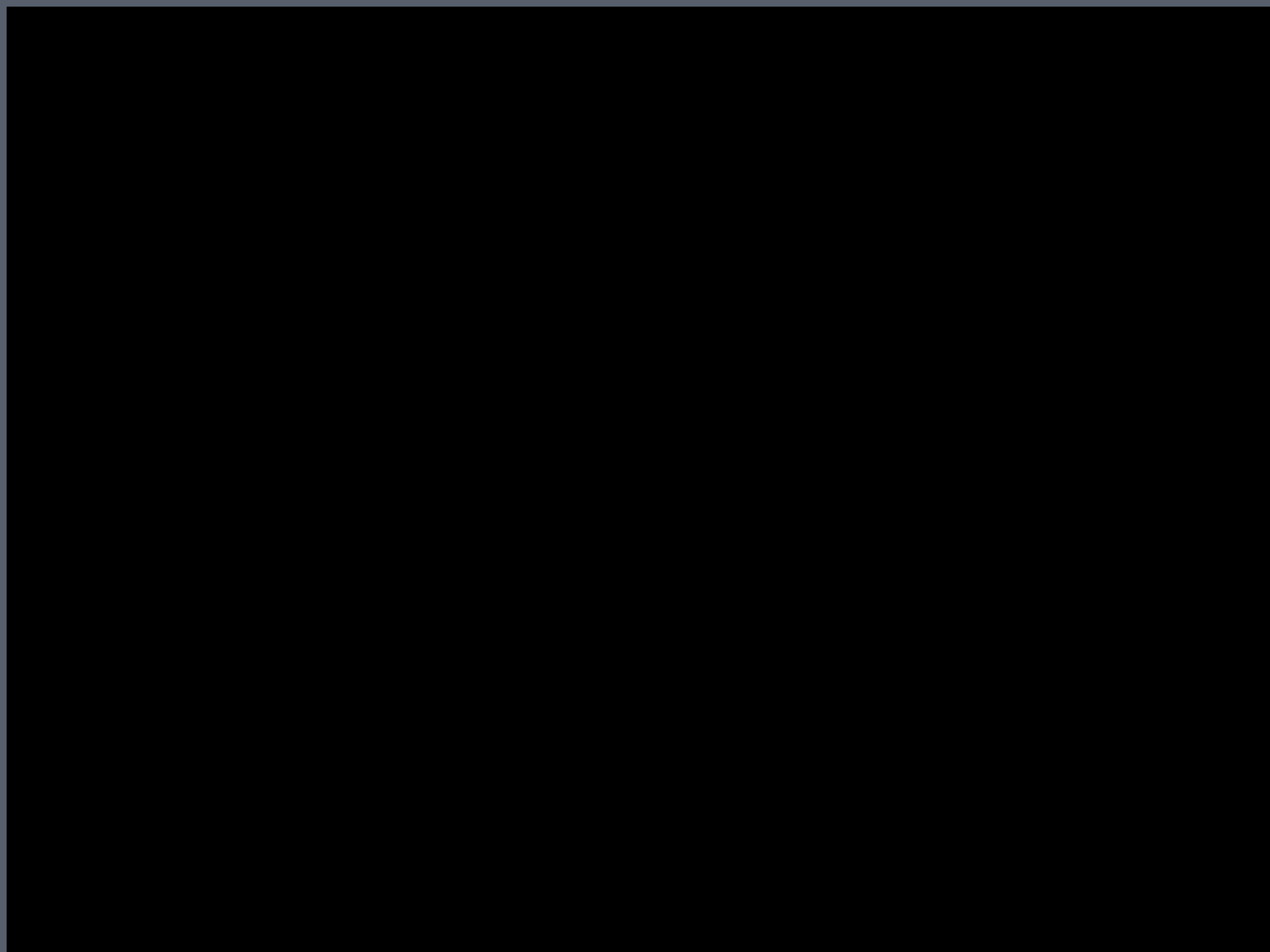
Negligible and Low		Moderate		High and Extreme	
Percentage	Number	Percentage	Number	Percentage	Number
69%	1,537,300	14%	301,700	17%	373,900

Top five counties by number of housing units in high and extreme wildfire risk categories

Jefferson	43,000
Larimer	38,300
Boulder	24,600

Top five counties by highest concentration of housing units in high and extreme wildfire risk categories

Gilpin	95%
Clear Creek	90%
San Miguel	85%



“The wildfire does gain or lose strength by the buildings that become fuel for the wildfire. It changes it,” said Anne Cope, the chief of engineering for the Insurance Institute for Business and Home Safety.

“The neighboring structures are a huge part of the overall risk for that one house.”

House Exposure-Results Matrix

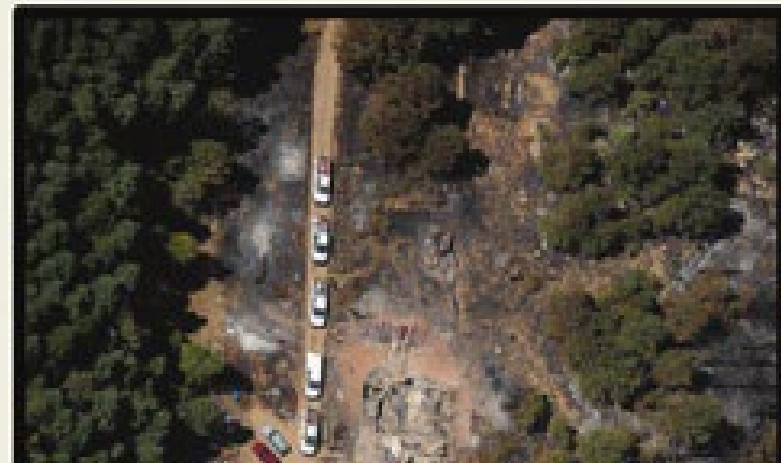
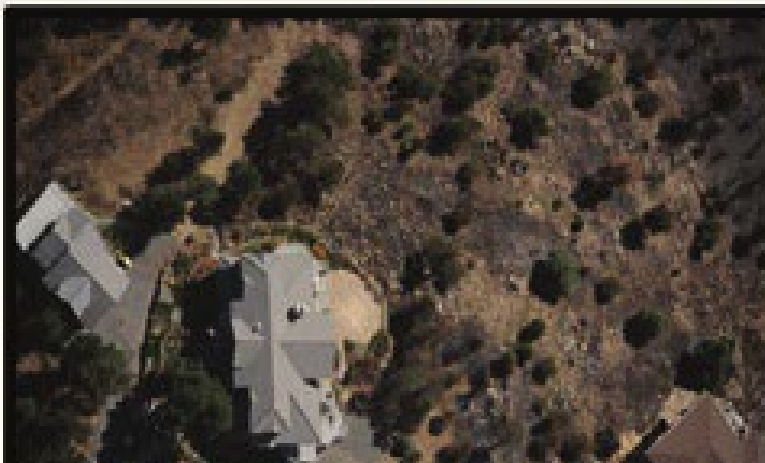
Survival

Destruction

**High
Intensity**



**Low
Intensity**



Requirements for Home Ignition

Flammable
parts of a
home

Firebrands and
burning objects
around a home

FUEL

HEAT



OXYGEN

Defensible Space

- Zone 3 >30 feet from dripline
- Zone 2 ~10' to 30' from dripline
- Zone 1 ~0 to 10' from dripline







Wildfire-Resistant Codes and Standards

While certain jurisdictional codes have been established, three existing statewide or national building codes and standards guide wildfire-resistant construction. They are:

- The International Code Council's International WildlandUrban Interface Code (IWUIC)
- The National Fire Protection Association's Standard for Reducing Structure Ignition Hazards from Wildland Fire (Standard 1144)
- The California Building Code Chapter 7A—Materials and Construction Methods for Exterior Wildfire Exposure.

Items To Consider in Structural Hardning

Soffit spaces

Gable ends

Overhanging
decks

Deck
construction
materials

Non-
combustible
siding (under 4')

Decoratve
combustible
landscaping

Non-
combustible
roofs

Noncombustible
fencing

Gutter
protection





QUESTIONS?



Thanks from---- Advanced Engineering Investigations
Jeff Berino- Senior Fire Investigator