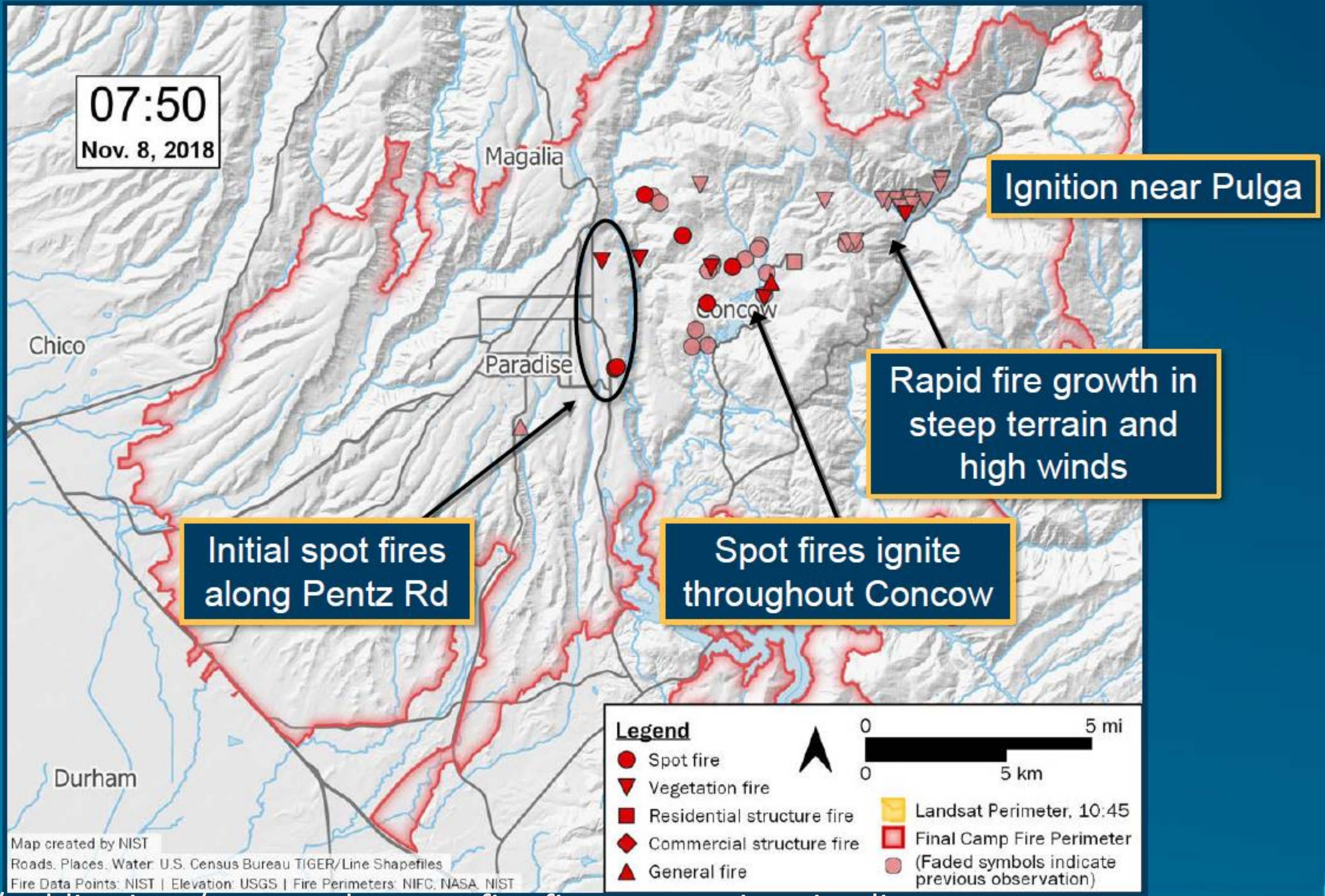
Wildfires and Risk Modeling

- What does a wildfire look like? The Paradise Fire timeline
- Anatomy of a wildfire. What are the key elements?
- Components of a wildfire risk model
- Model validation challenges

Fire Progression Summary 06:15 to 07:50

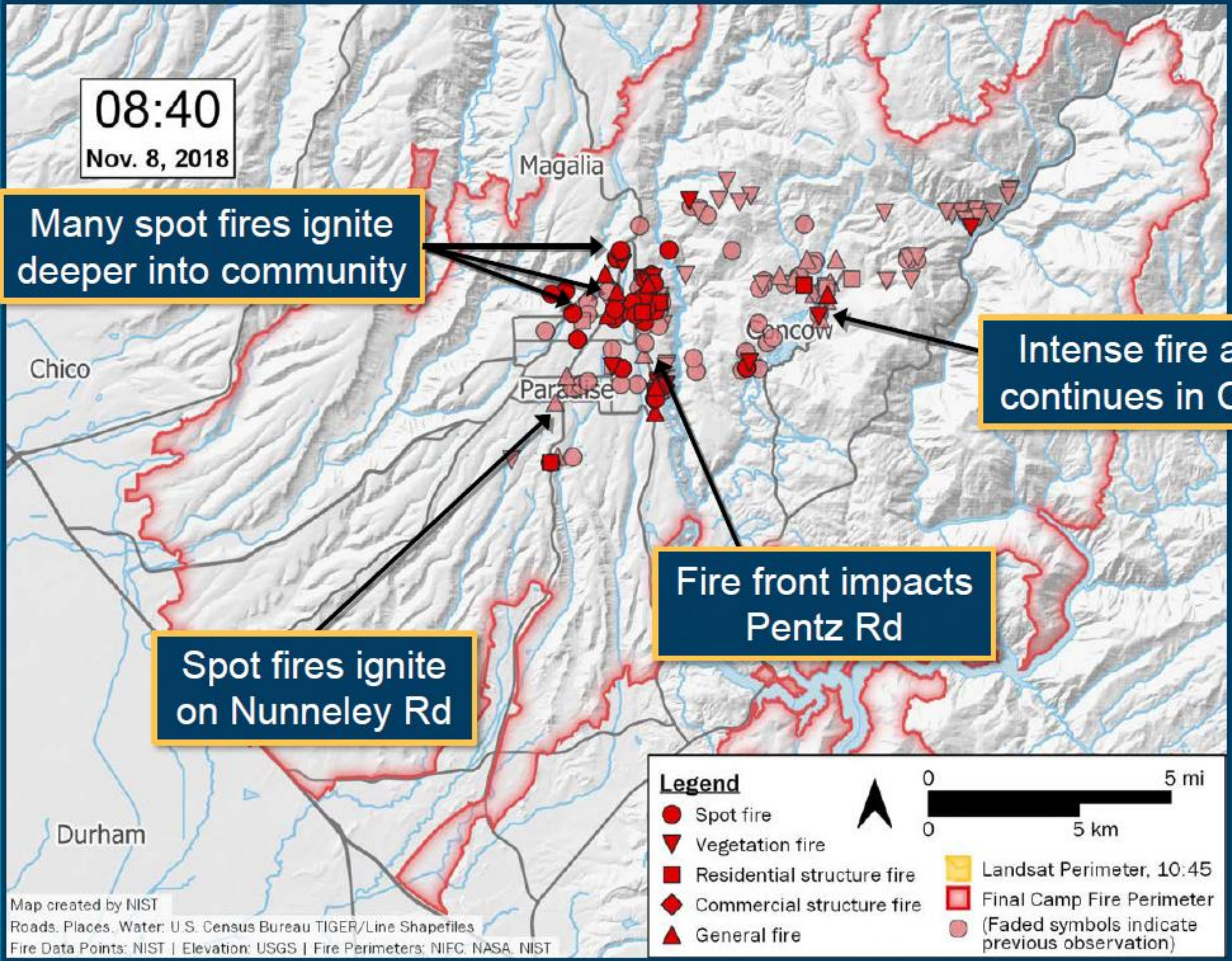
National Institute of Standards and Technology
U.S. Department of Commerce



From: https://www.nist.gov/publications/case-study-camp-fire-fire-progression-timeline

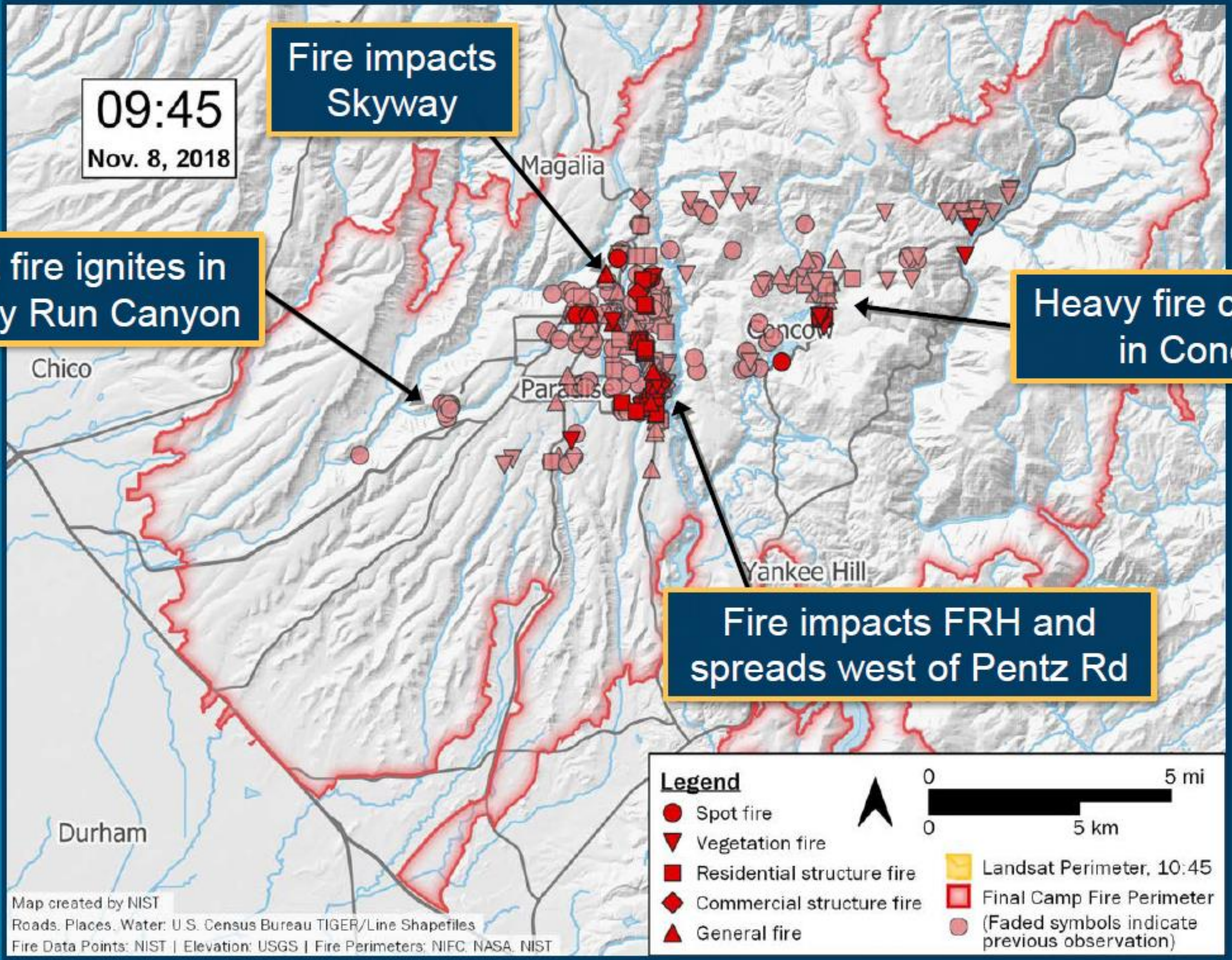
Fire Progression Summary 07:50 to 08:40

NIST
National Institute of Standards and Technology
U.S. Department of Commerce



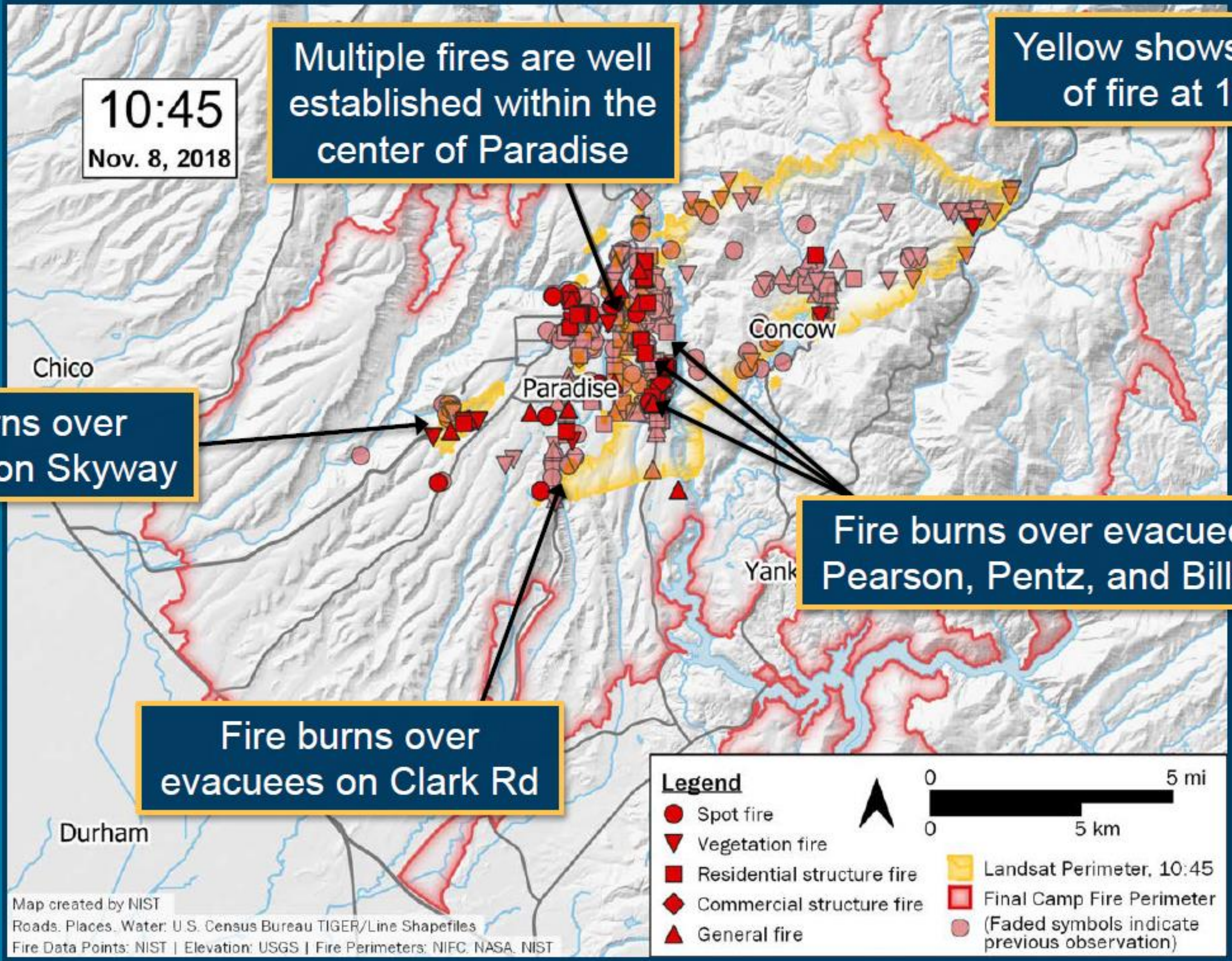
Fire Progression Summary 08:40 to 09:45

NIST National Institute of Standards and Technology U.S. Department of Commerce



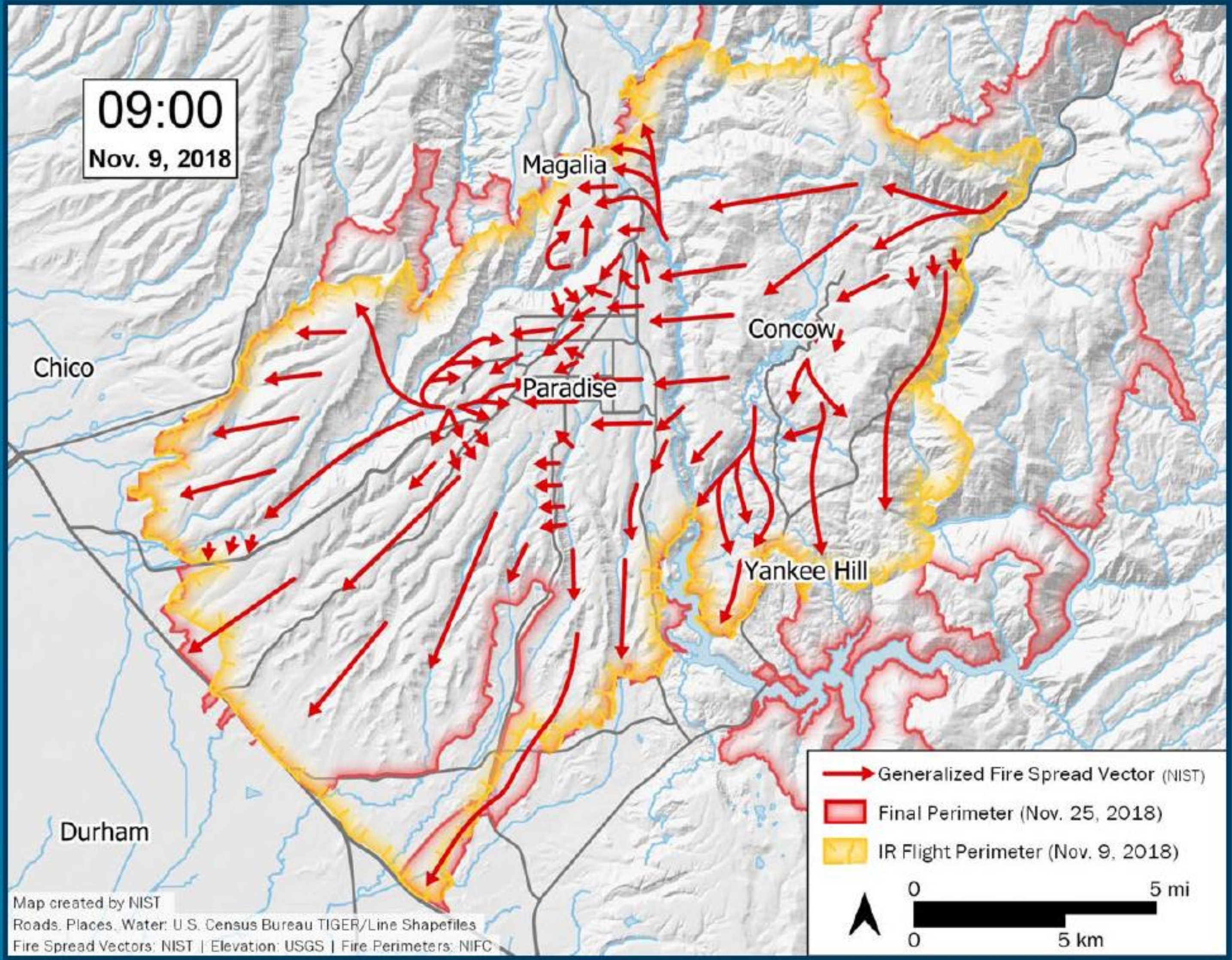
Fire Progression Summary 09:45 to 10:45

National Institute of Standards and Technology
U.S. Department of Commerce



Fire Progression Summary (Day 1)

NIST
National Institute of Standards and Technology
U.S. Department of Commerce



NIST Camp Fire Report #3, Figure 22.

engineering laboratory

Add comr
tools

CoreLogic

Notable recent wildfires

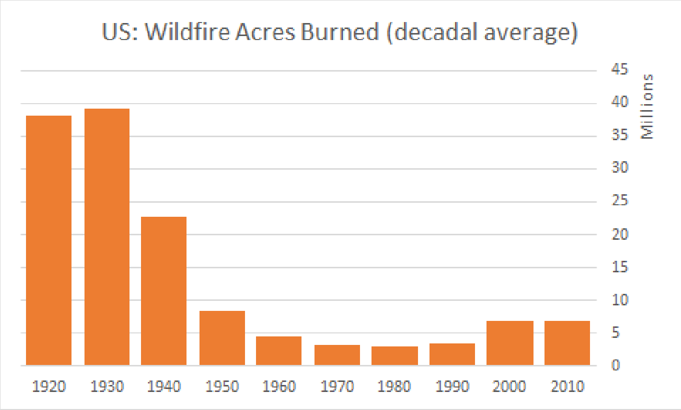
Common elements – short duration for damage

Fire	Wind	Structures	Duration 80%+
Tubbs 2017	60 mph	5,643	8 hrs
Camp 2018	35 mph	18,804	8 hrs
Marshall 2021	115 mph	1,084	6 hrs

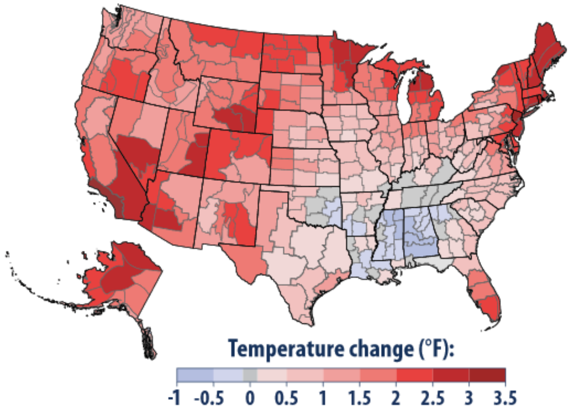
The physical fire lasted much longer. Most damage to property occurred in the initial period

Most property losses occur while fire services are focused on protecting lives, or as they transition to defending property

CA Wildfire Risk:
The future does not look like the past

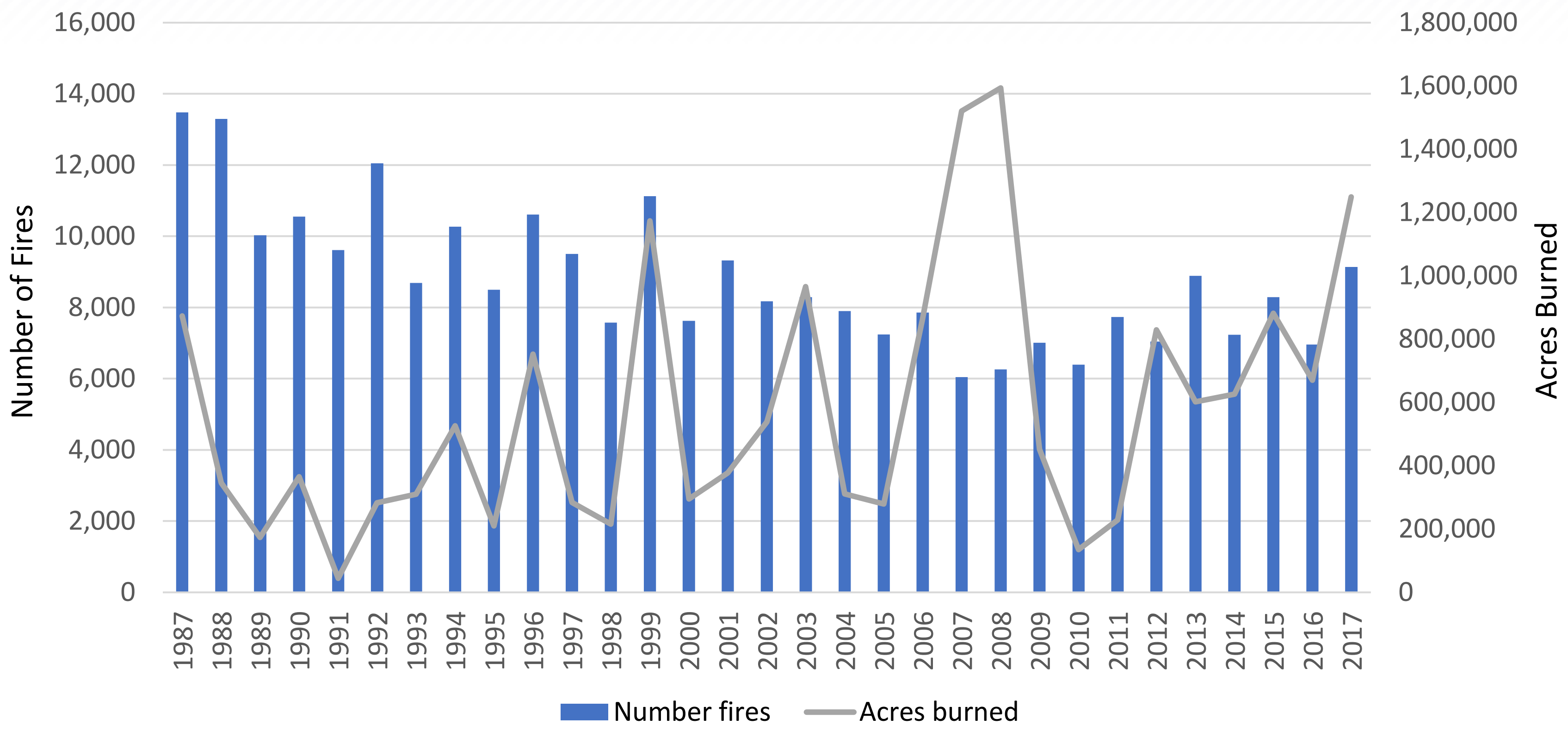


- Wildfire fuel (unburnt vegetation) is increasing every year
- Summers are getting longer and hotter (climate change)
- Housing growth in WUI continues unabated
- New forestry management mitigation programs are being introduced
- In total
  - We cannot expect the future risk of wildfires to mimic the past
  - Planning requires something beyond experience rating



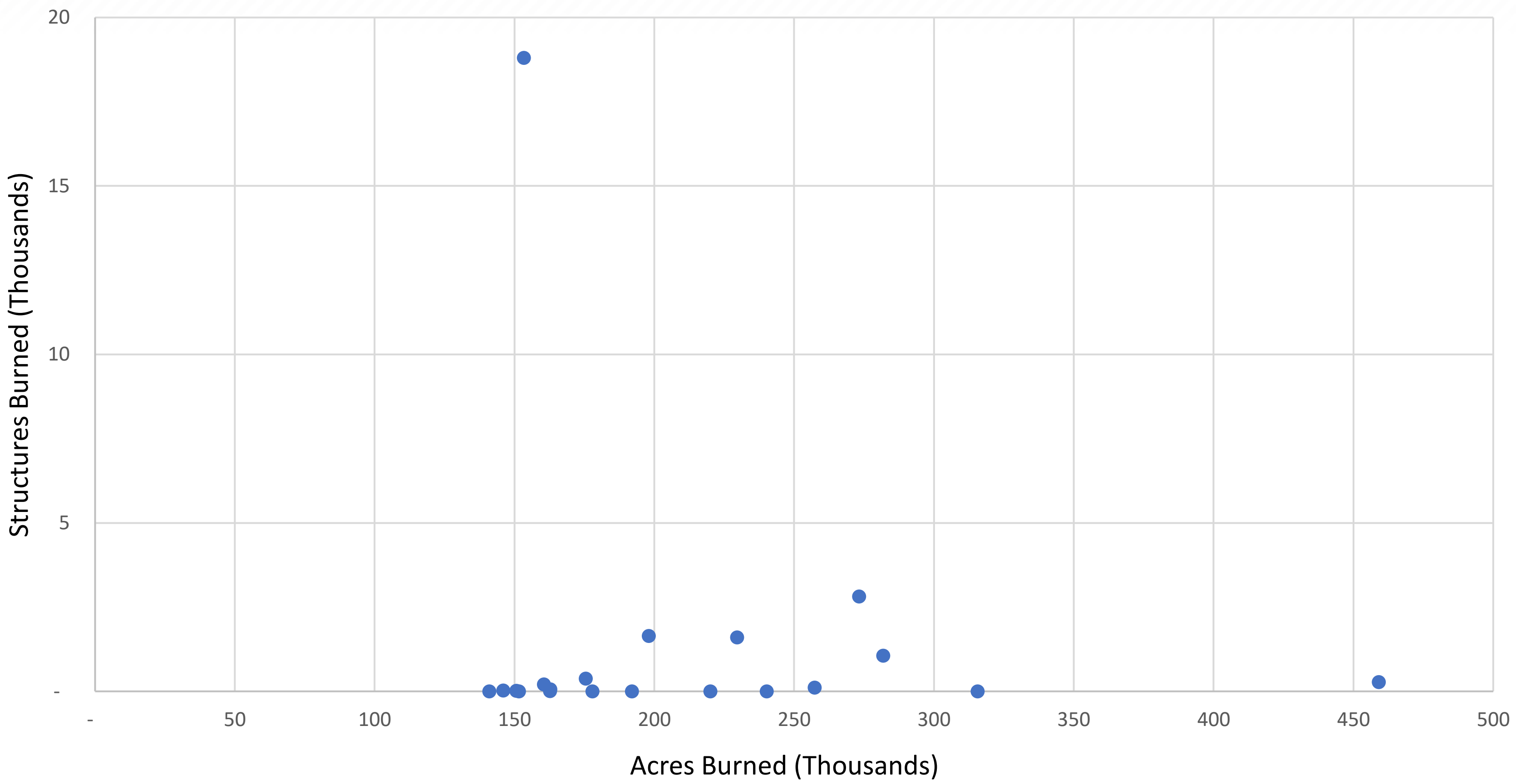
Growth in CA WUI
33% more in 20 years

California Fires and Acres



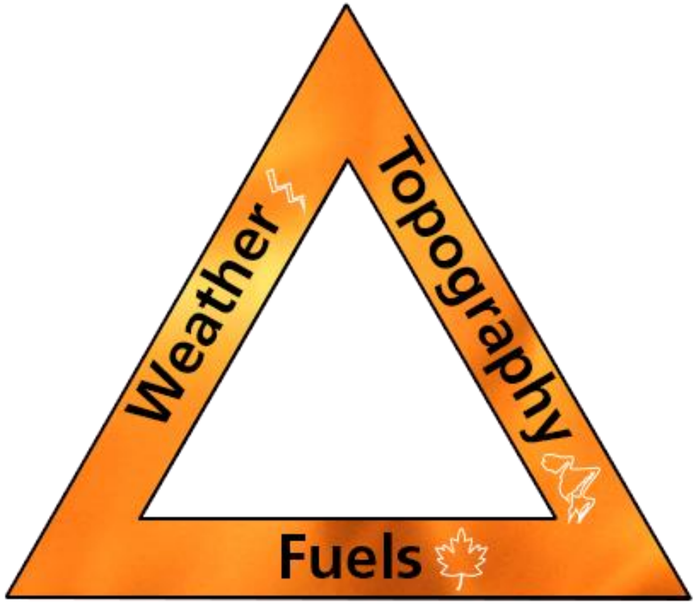
- Source: California Department of Forestry and Fire Protection, 2018

Fire Size vs. Homes Burnt, California Top 20



- Source: California Department of Forestry and Fire Protection, 2018

The key elements to a wildland fire

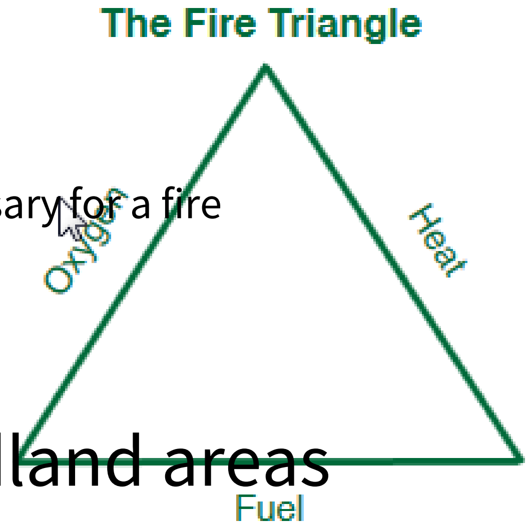


- Weather includes temperature, wind speed and direction, humidity
- Topography is shape of the land, as well as elevation, slope and aspect.
- Fuels - moisture level, chemical makeup, and density - the degree of flammability

Characteristics of large fires in California

Understanding the peril of extreme fires

- Late season (**Fuel**)
  - largest fires were between September and November
  - California dry summer weather pattern produces the fuel necessary for a fire
- High winds for multiple days (**Oxygen**)
  - High winds provide the oxygen necessary for a large fire
- Suburban concentrations in and near wildland areas (**Heat/Ignition**)
  - Human activities provide the "heat" in the form of incidental ignitions

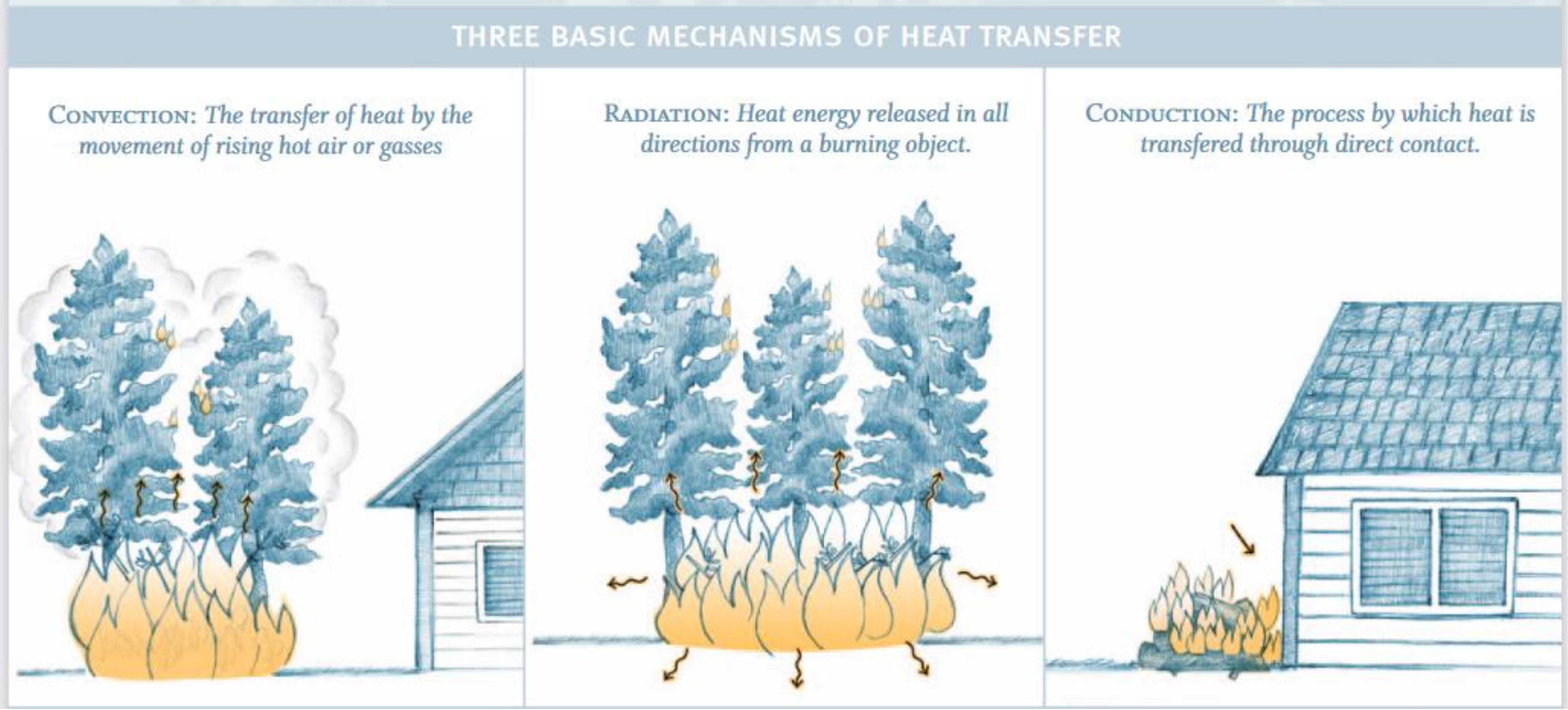


The fluid dynamics of wildfire

- The influence of the fire–atmosphere coupling is much greater in wildland fires than in building fires.
  - The influence of the fire–atmosphere coupling is much greater in wildland fires than in building fires.
  - wildland fuels are primarily fine, they are also efficiently cooled when the surrounding ambient air is cooler than they are. That means that the indraft of air caused by a fire may actually impede its spread.

Understanding Fire Behavior

Heat Transfer



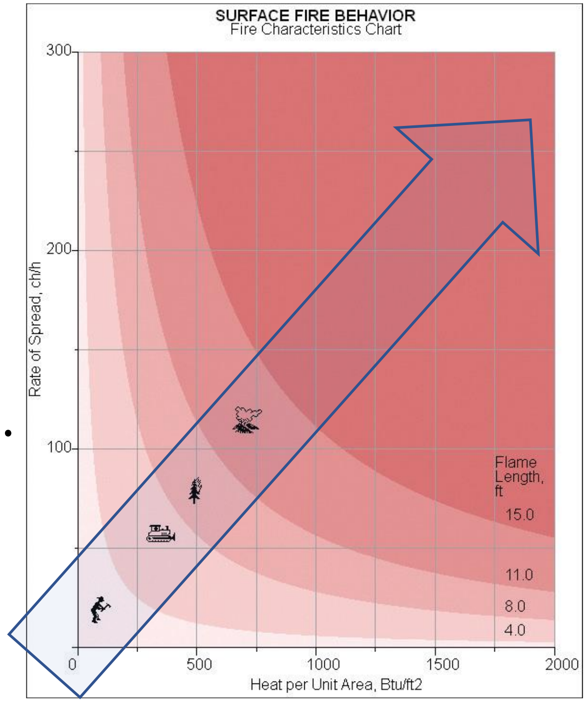
From: https://www.srs.fs.usda.gov/factsheet/pdf/fire-understanding.pdf

Anticipating ultimate fire losses

Modeling the physics of a wildfire

Increasing fireline intensity equates to increasing difficulty to fight fire

- Wildland fires are distinct from smaller fires
  - Driven by winds
  - Influenced by fuel loads and topography
- The shape and eventual extent of the fire are driven by many localized geographic and climate factors
- As fireline intensity increases, the ability to constrain the fire decreases.
  - Hand crews can only fight fires to a certain size
- Slope plays a secondary impact
  - The inability to maneuver heavy equipment can impede fire fighting



Scott, Joe H. 2012. Introduction to Wildfire Behavior Modeling. National Interagency Fuels, Fire, & Vegetation Technology Transfer. Available: www.niftt.gov.

Wildland Fire – not like other loss perils

Wildland fire is a full loss peril

- Fires destroy the entire building and stresses the 100% reconstruction cost for the policy
    - Not even hurricanes or earthquakes cause widespread 100% loss severity
    - Under-insurance will be exposed in a wildfire
- California Dept of Insurance (CDI) may be increasing costs for contents and ALE coverage[1] beyond historic claims
- Coverage C loss exposure remains ambiguous
    - Valuation methods not as rigorous as for Coverage A

Larkfield area, Santa Rosa Fires, 2017

1-http://www.insurance.ca.gov/0400-news/0100-press-releases/2018/upload/nr086NoticeExpeditedClaimsProcedures.pdf

Roofing Type Classes

(Based on UL 790 (ASTM E 108) Standard Test Method)

- **Class "A":** The highest fire-resistance rating for roofing as per ASTM E-108. Indicates roofing can withstand severe exposure to fire originating from sources outside the building.
- **Class "B":** Fire-resistance rating that indicates roofing materials can withstand moderate exposure to fire originating from sources outside the building
- **Class "C":** Fire-resistance rating that indicates roofing materials can withstand light exposure to fire originating from sources outside the building
- **Class “U”:** Unrated e.g. Wood Shingle
- Default Class is set to “U” unless we can smart default on Building Code

Additional Secondary Structure Modifiers

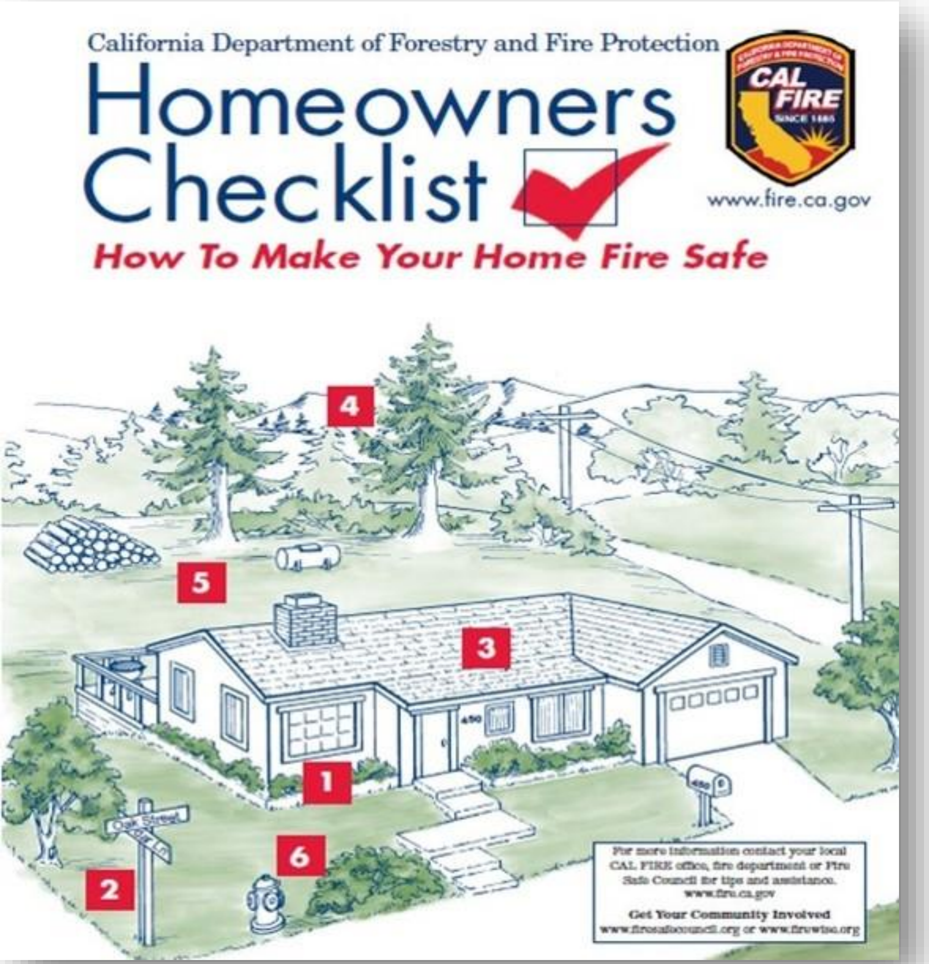
- **Fire Resistive Siding**
- **Fire Resistive Windows**
- **Non Combustible Attachments**
  - Fences + Decks
- **Automatic External Fire Extinguishing System**
  - The most effective protection
  - Needs water reservoir, pump and electric supply with battery back-up to be fully effective
- **Structure Fire Vulnerability Mitigated**
  - Ensuring Fire Embers cannot enter the structure by using screening across ventilation, protecting eaves
  - No accumulation of debris on roofs and in gutters

Perimeter Clearance

CALFire Defensible Zones endorsed by the Insurance Institute for Business & Home Safety
(IBHS)

Description	Clearance Range
Lean, Clean and Green Zone	0’ to 30’
Reduced Fuel Zone	30’ to 100’
Non combustible Zone	0’ to 5’

Mitigation Strategies



Attribution: CalFire http://www.calfire.ca.gov

Attribution: IBHS http://disastersafety.org/legal/

Mitigation Examples (IBHS Examples)

Underneath decks

Unenclosed

Debris

Unenclosed eaves
Vents

Validating a Wildfire model with experience data

Some techniques from hurricanes and earthquakes won't work

- Loss experience model comparisons for HU and EQ work well
  - Hurricane Andrew generated about 2M claims
  - Northridge EQ affected about 3M homes
  - As of 25 October, Hurricane Ian has ~600k claims[1]
- Wildfires and SCS are different
  - Large wildfire is 10,000 homes
  - Large thunderstorm damages 5,000 homes
- How the loss-experience is brought forward for comparison to model results on today's portfolio has a large influence on results

1 - https://www.floir.com/home/ian, 1 Nov 2022

One example from wildfire

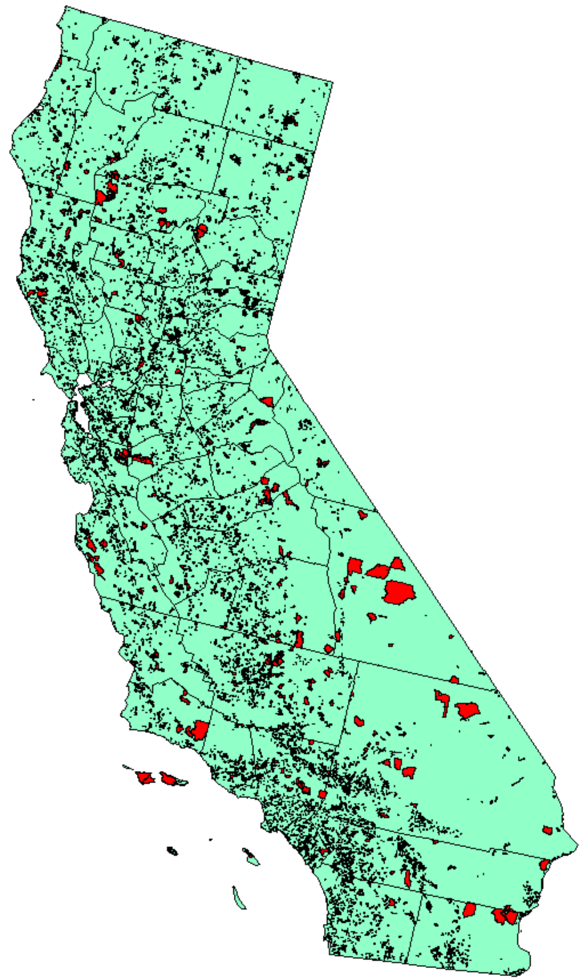
San Diego, CA

- Observation: (apparent) big model mis-match in re-simulation of San Diego wildfires in 2003 and 2007
  - State-wide housing growth is about 2% per year
  - Within the fire footprints, housing growth was about 4% per year (much higher than state, county averages).
  - Re-analysis of today portfolio showed losses than did not agree
- Earthquakes and Hurricanes affect enormous areas, and small-scale anomalies are averaged out
  - Hurricane Ian claims represent 8% of entire state!
  - Not true for SCS or wildfire

Aspects of bringing historic losses to present

Some are challenging

- Shown: the 44,112 census blocks that in 2010 contained almost 750,000 homes yet in 1990 there were none
- These homes are
  - Disproportionately in wildland areas
  - Frequently within historic wildfire footprints
  - Not existing at the time of the last fire



Managing and Mitigating wildfire

Proceeding to a manageable level of risk

- Wildfire has 3 critical aspects
  - Ignition
  - Fire spread to homes
  - Home destruction

Related to human activities. Can be reduced but not eliminated

Regional fuel reduction to slow fire, make it fightable

Harden homes. Can reduce but not eliminate risk.