2012 Waldo Fire – WUI Case Study

NIST WUI FIRE DAYS 2022

Photo courtesy of Colorado Spring Fire Department – Used with permission

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Investigation Findings

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1. WUI fires – different from Wildland and Urban fires
2. First responder defensive actions very effective
3. Exposures (fire and embers) drive WUI fire dynamics

Waldo Canyon Fire

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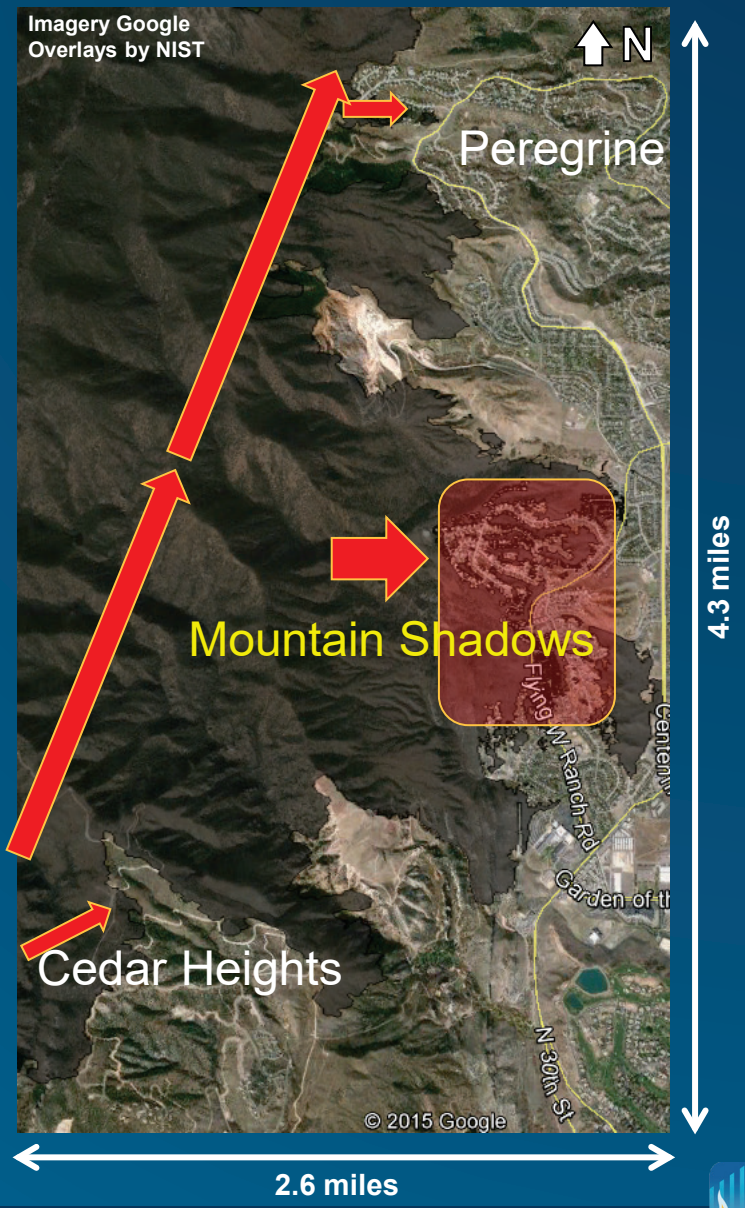
- June 26 to 27, 2012
- Wildland fire spreads into WUI
- Colorado Springs Communities affected:
  - Peregrine – 0 homes destroyed
  - Mountain Shadows – 344 homes destroyed – 95% in 6 hours
  - Cedar Heights – 0 homes destroyed
- Data Collection:
  - Over 200 technical discussions with first responders
  - 4,500 distinct fire observations and/or defensive actions for ~8 hours of incident.



What Happened Initially?

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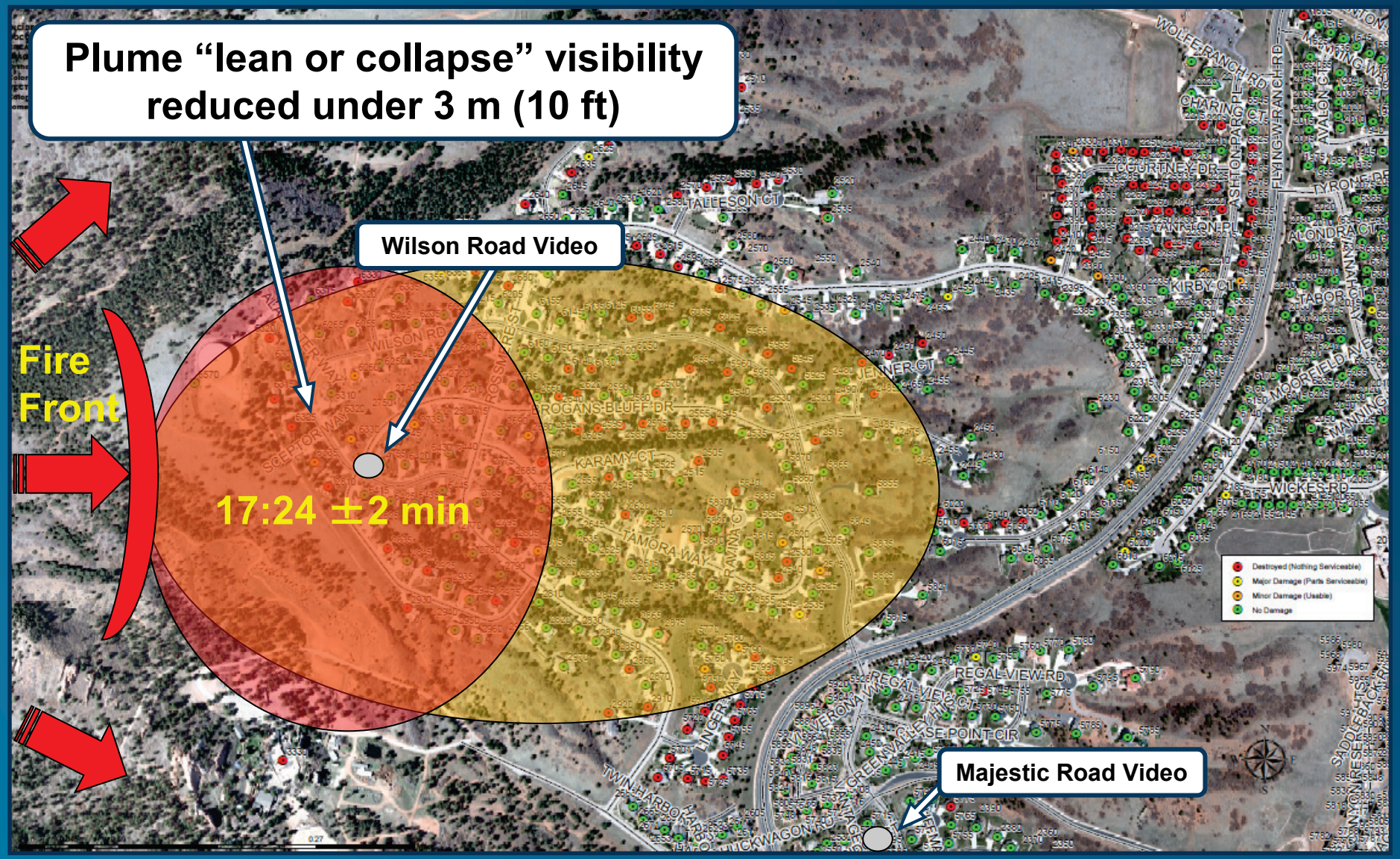

Graphics represent approximate locations/sizes

Waldo Canyon Fire

- 48 ignitions from wildland fire:
  - overwhelmed the traditional fire response
  - 100 structures on fire first hour
- Structure to structure fire spread majority of structural losses

Photo courtesy of CSFD.
Used with permission.

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Structure Ignitions

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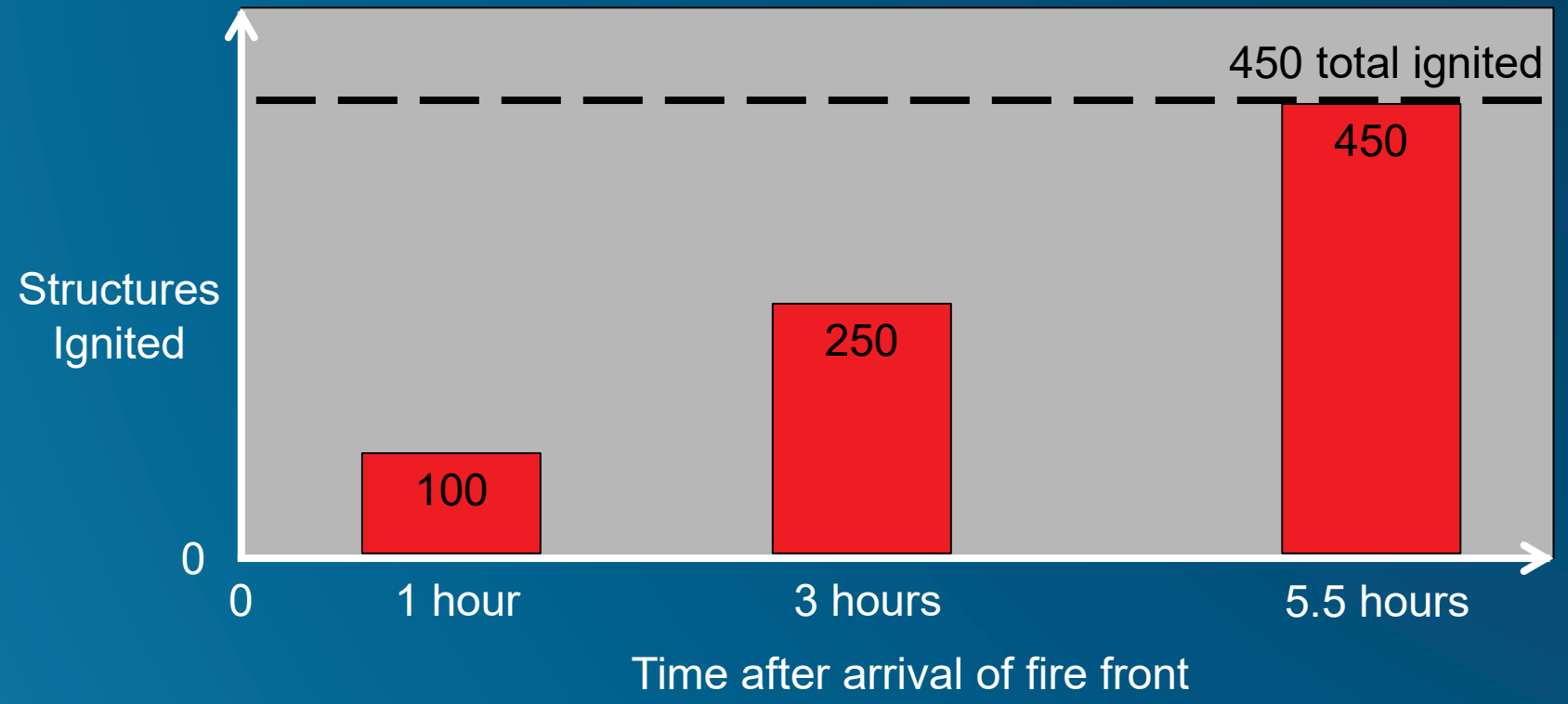
Thermal Radiation

Flame Contact

Embers

WUI Fires are Different – Rapid Ignitions



~ 1 home/minute destroyed

100 initial ignitions in the first hour contribute to an additional 350 ignitions

Apparatus in Mountain Shadows

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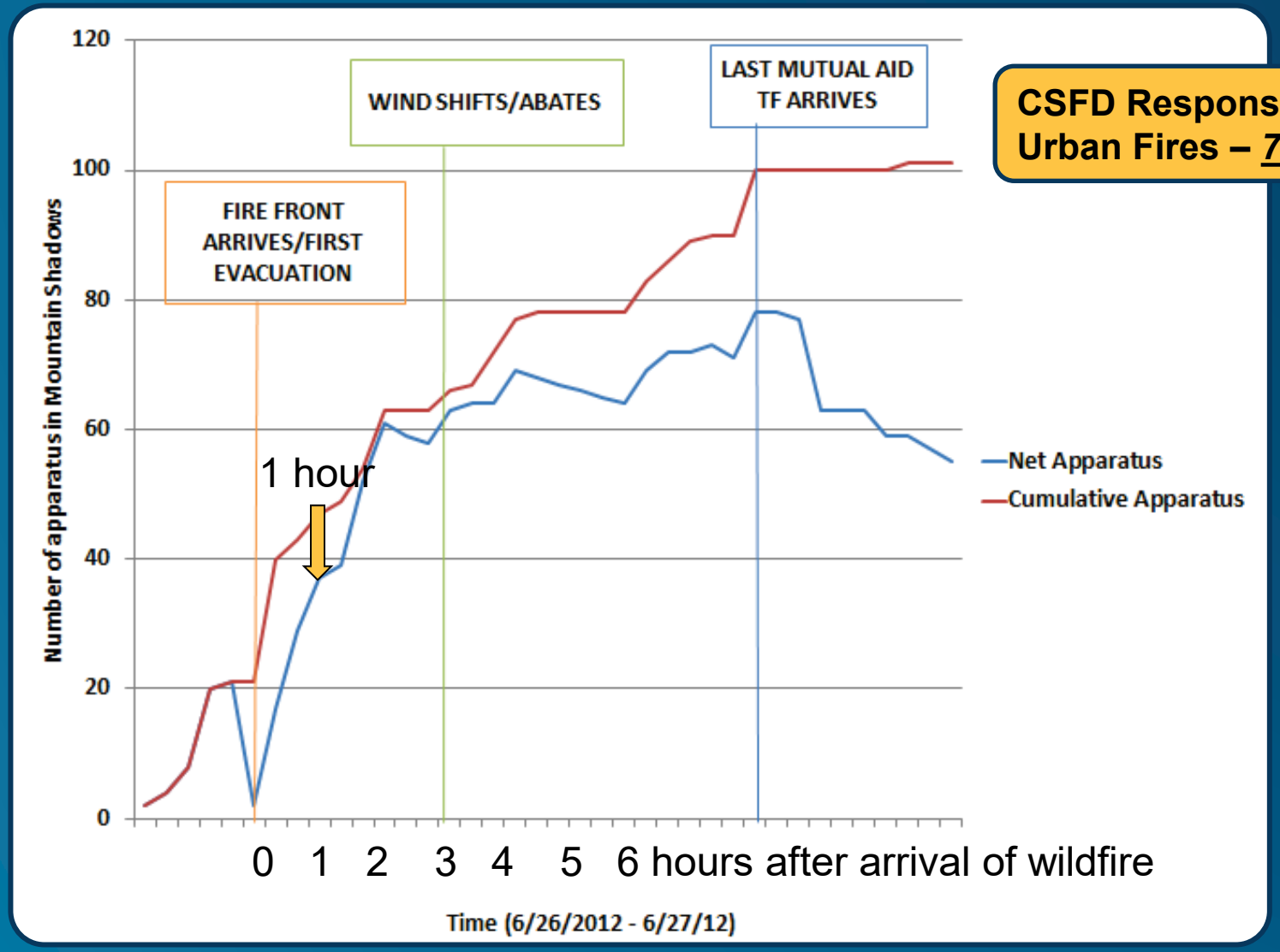


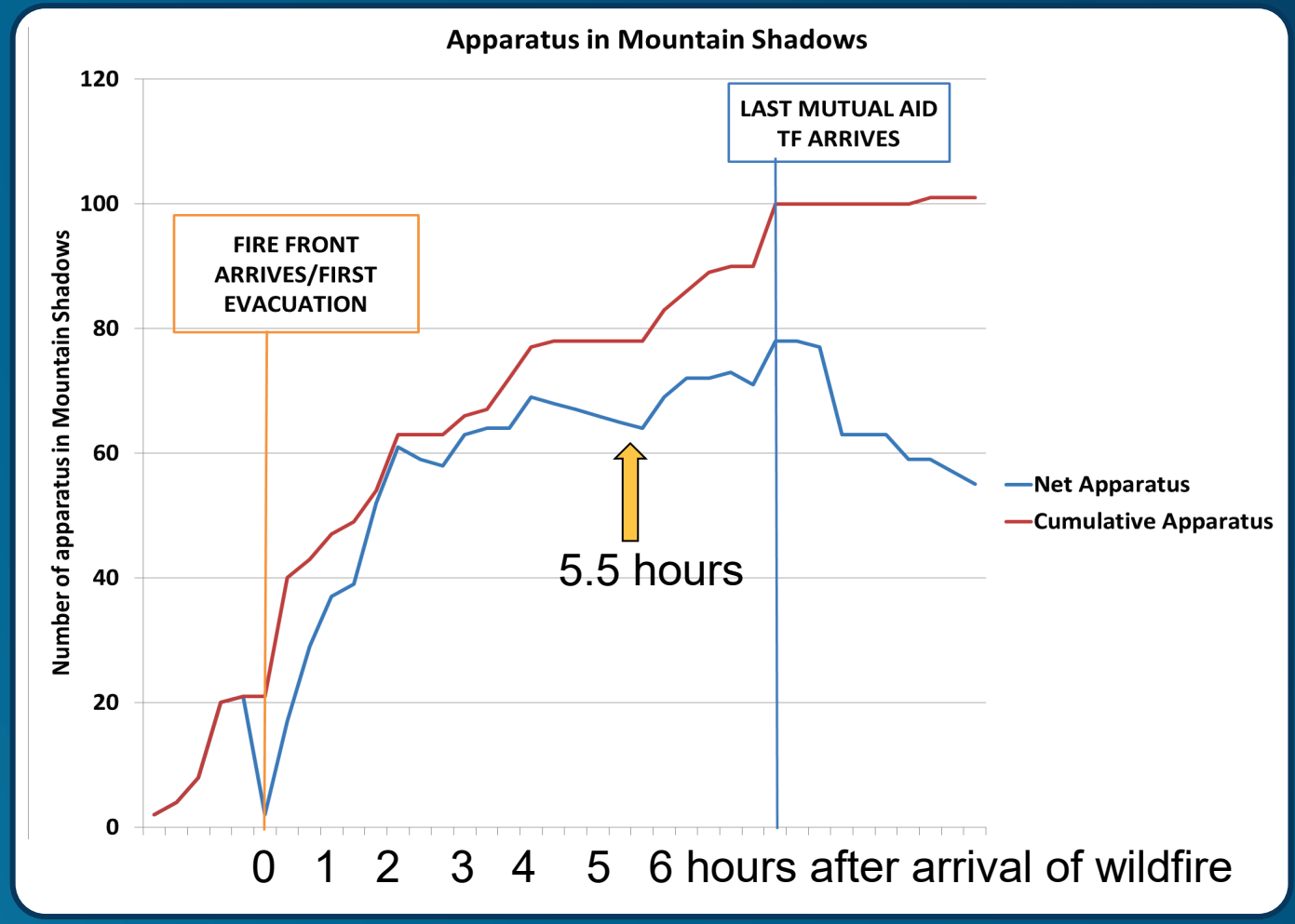
CSFD Response Goal for Urban Fires – *7 to 9 Minutes*

NIST Technical Note 1910, Figure 58.

Wilson Road – 1 Hour After Arrival of Fire Front

Video/Images: Colorado Springs FD, used with permission

Short WUI Fire Event – over in 5½ h



Waldo: 344 homes destroyed in 5.5 hours
~ 1 home/minute destroyed

NIST Technical Note 1910, Figure 58.

Short WUI Fire Event – over in 5½ h




Video/Images: Majestic Drive, Colorado Springs FD, used with permission

WUI Fires – Require Rapid Response

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Urban Response	Urban Fire Extent of Damage	WUI Response	WUI Fire Extend of Damage	Wildfire Response	Wildland Fire Extent of Damage
One Fire Department Multiple Fire Stations	Room of origin (seconds to minutes)	Multiple Fire Departments and Jurisdictions ***Mutual Aid***	Interface boundary (minutes to hours)	Multiple Land Owners and Jurisdictions ***Mutual Aid***	100 acres (hours to days)
	Floor of origin		Neighborhood		1,000 acres
	Building of origin		Community		10,000 acres
	Surrounding buildings		Part of City		100,000 acres
SOPs in place to work together across stations		**Incident response must be developed BEFORE the Incident**		Time available to coordinate deployment	

Urban fires: seconds count
WUI fires: minutes count
Wildland fires: hours count

WUI Fires are Different – Community/Parcel/Building Exposures

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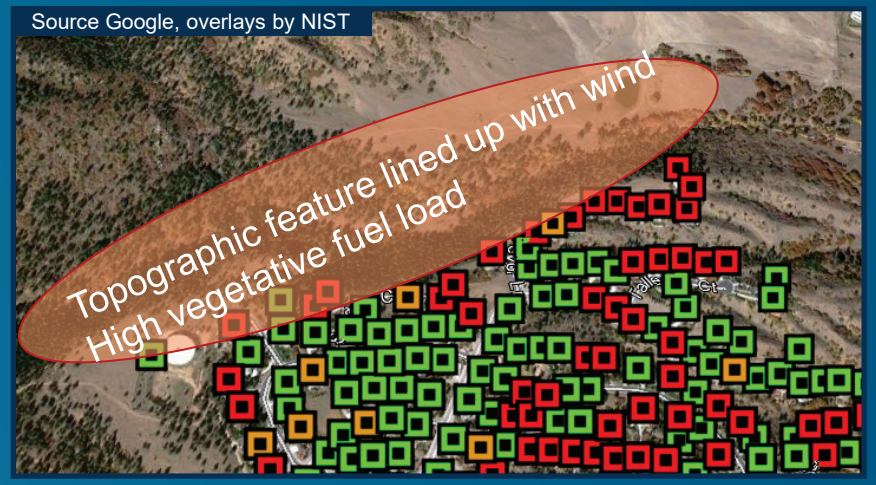
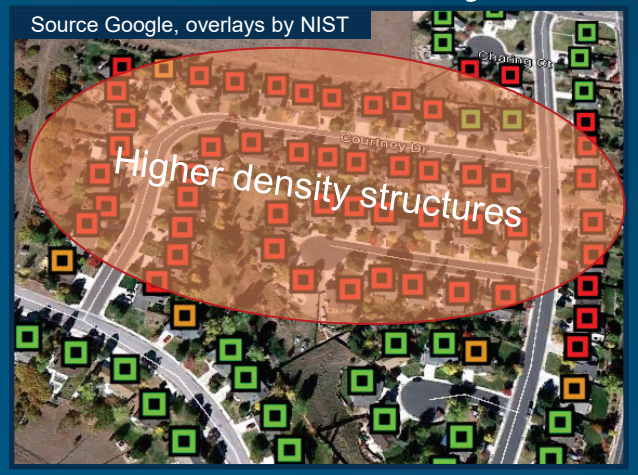
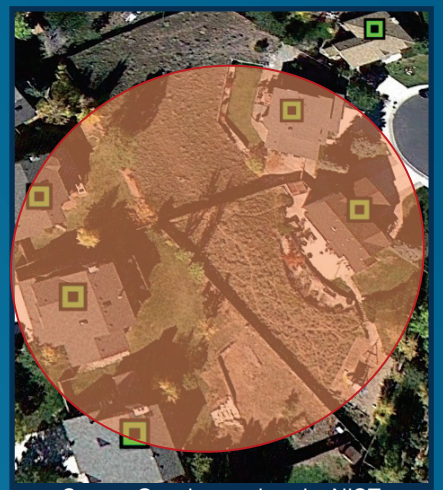
Around Communities



At Community Level





At Parcel Level

- Combustible decks
- Combustible fences
- Railroad ties
- Secondary buildings
- Re-entrant corners
- Readily ignitable roof coverings

Defensive Actions Were Effective

Table 5. Defensive actions identified in NIST post-fire case studies.

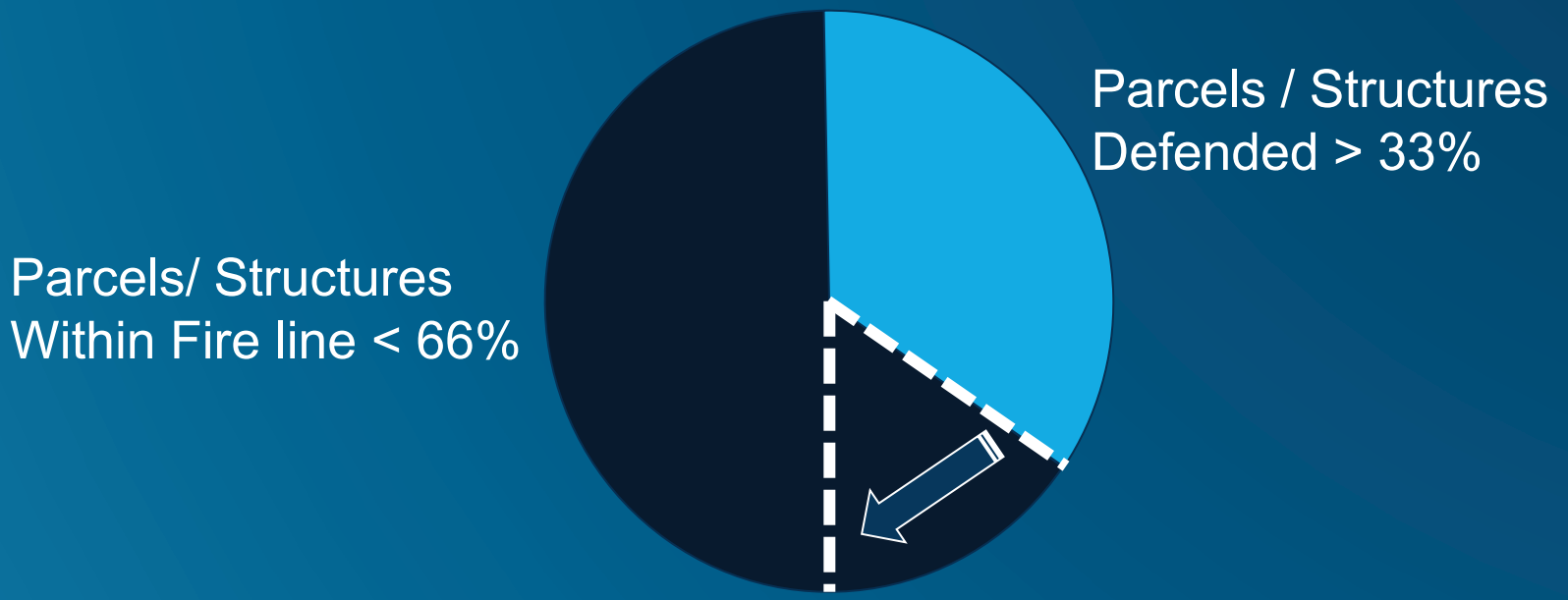
Case Study	Structures in Case Study	Damaged Structures	Damaged Structures Identified as Defended	% of Damaged Structures Identified as Defended
Witch/Guejito	245	16	15	94 %
Tanglewood Complex	179	13	11	85 %
Waldo Canyon	1455	101	94	93 %

NIST Technical Note 2205 (HMM), Table 5.

39% of undamaged structures within the fire perimeter were defended

NIST Technical Note 1910, Section 11.2.1 and Map Figure 29.

WUI Defensive Actions Were Effective – Impact Fire Outcome



Defensive actions - alter WUI event severity and extent of loses

WUI Defensive Actions Were Effective

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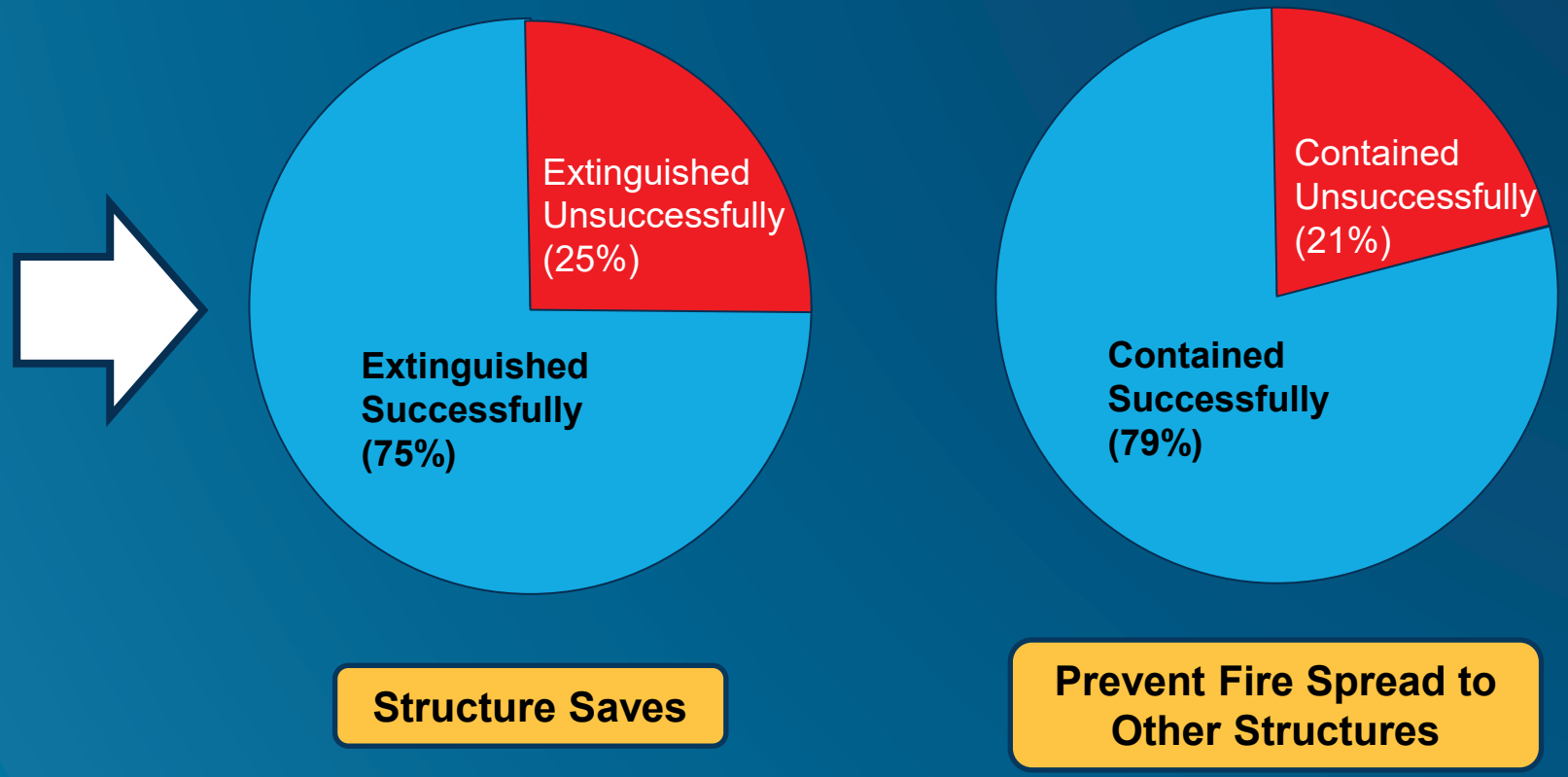
Saving Structures –

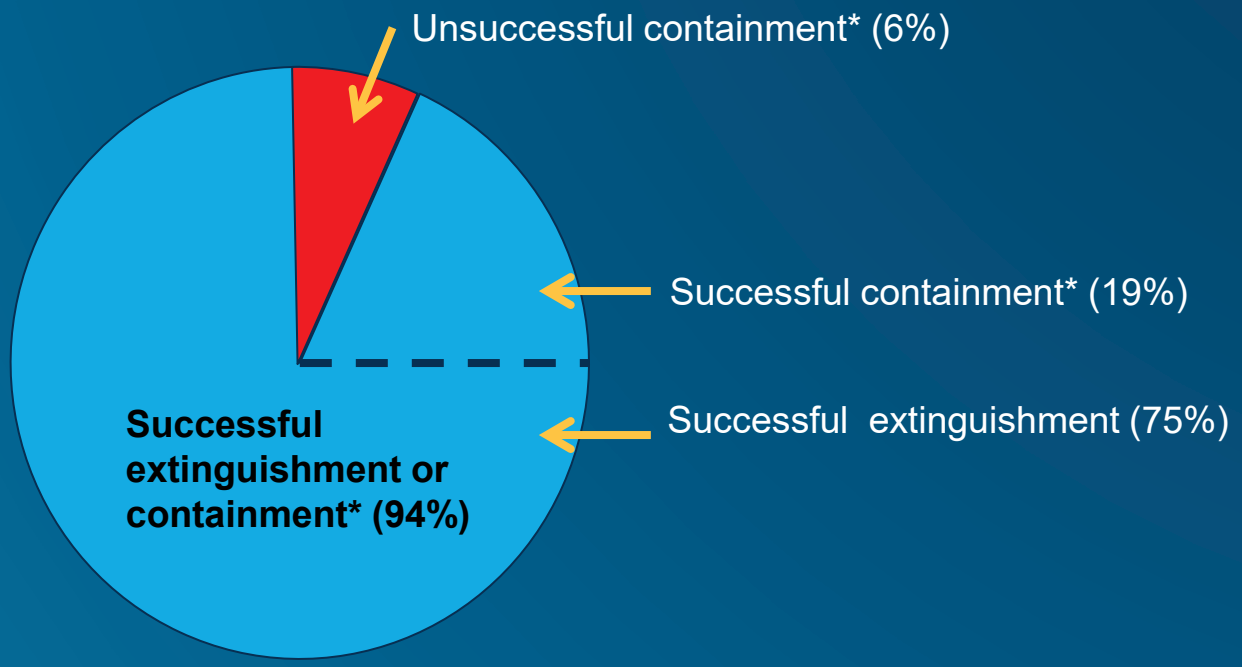


Structure Saves

Prevent Fire Spread to Other Structures

WUI Defensive Actions Were Effective

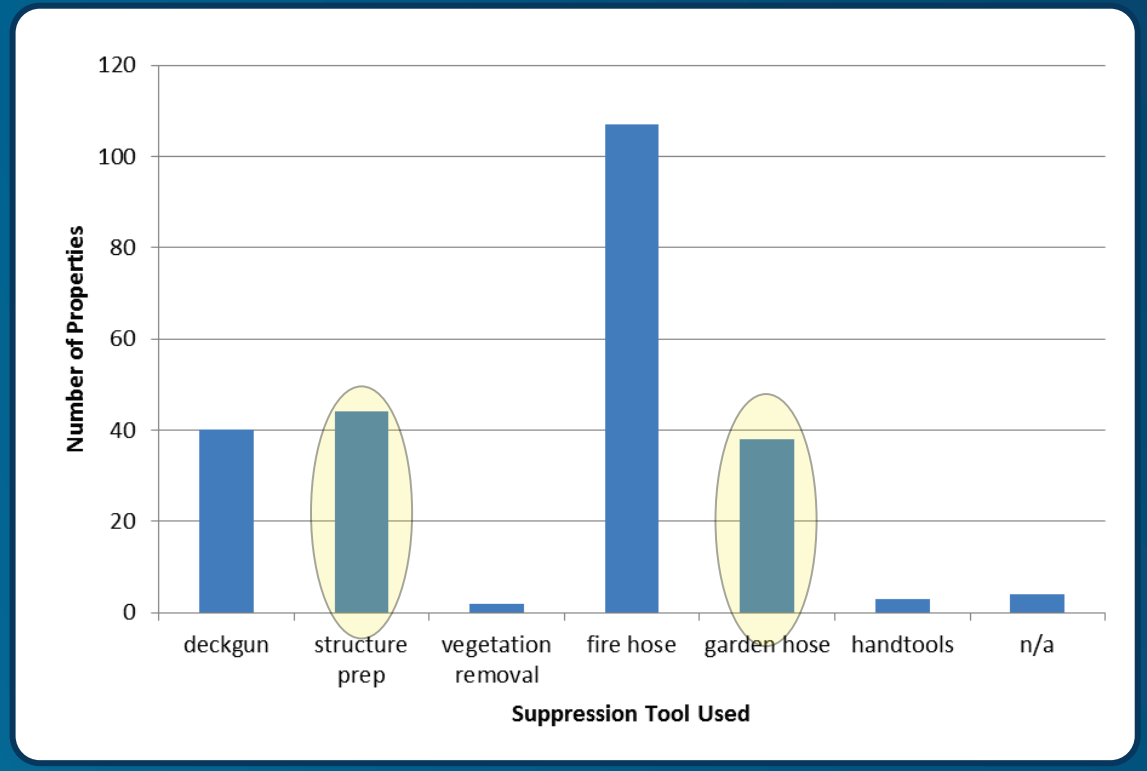
Stopping Fire From Spreading –



* Containment following unsuccessful extinguishment

Exposure Driven Response at the Interface

Waldo Fire - Counts of undamaged structures defended with various suppression tools.



Suppression activities in low exposure environments can significantly reduce structural loses.

* Exposure is connected to hazards. High exposures and hazards must be identified prior to the incident. Extensive work is necessary to develop safe WUI fire fighting tactics.

NIST Technical Note 1910, Figure 48.

WUI Defensive Actions Were Effective

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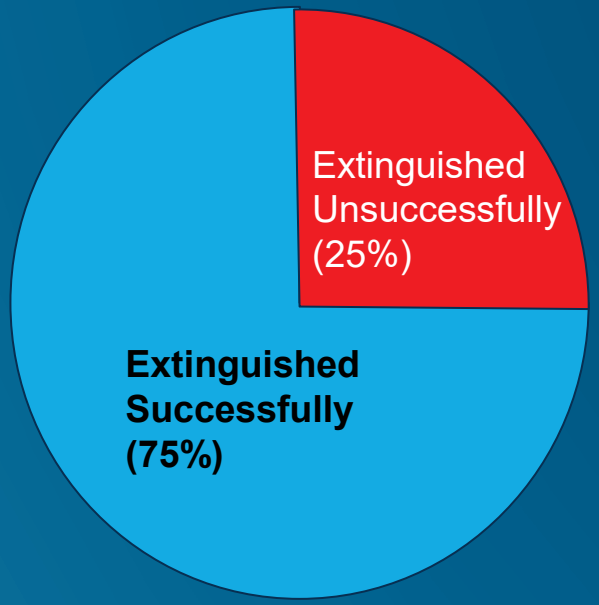
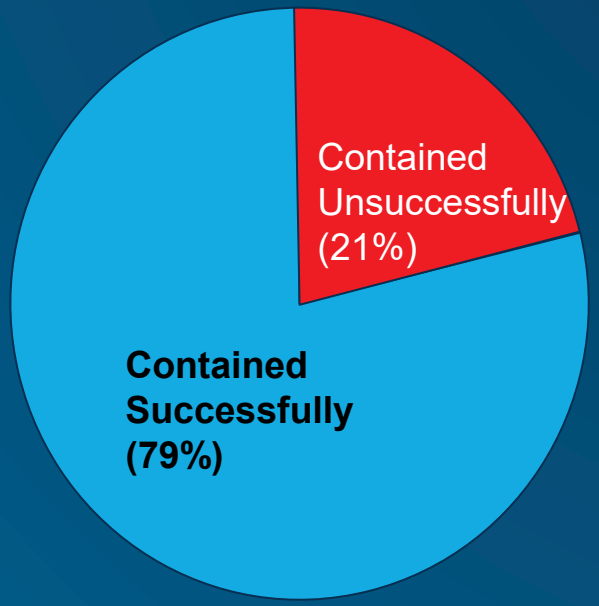


Structure Saves



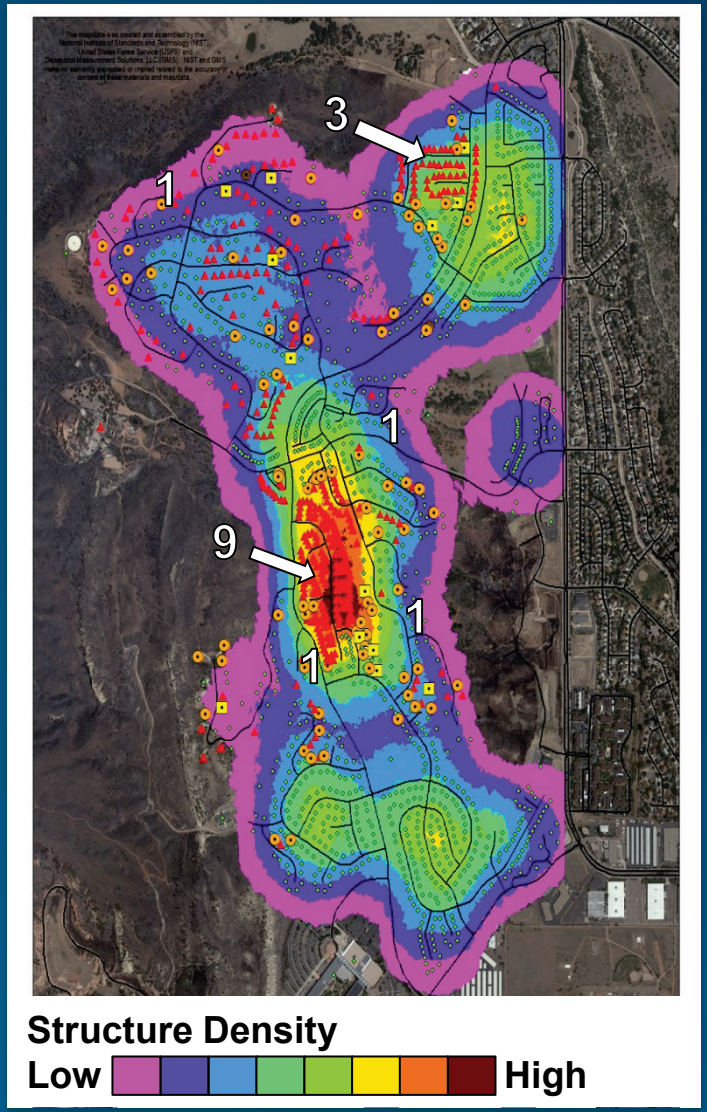
Prevent Fire Spread to Other Structures

High Density Structures Dominate Unsuccessful Containments

12 out of 16 Structures were in:

- High Fire Exposure
- High Density of Structures

Structure density impacted containment



NIST Technical Note 1910, Section 11.5 and Map Figure 13.

Surviving Structures

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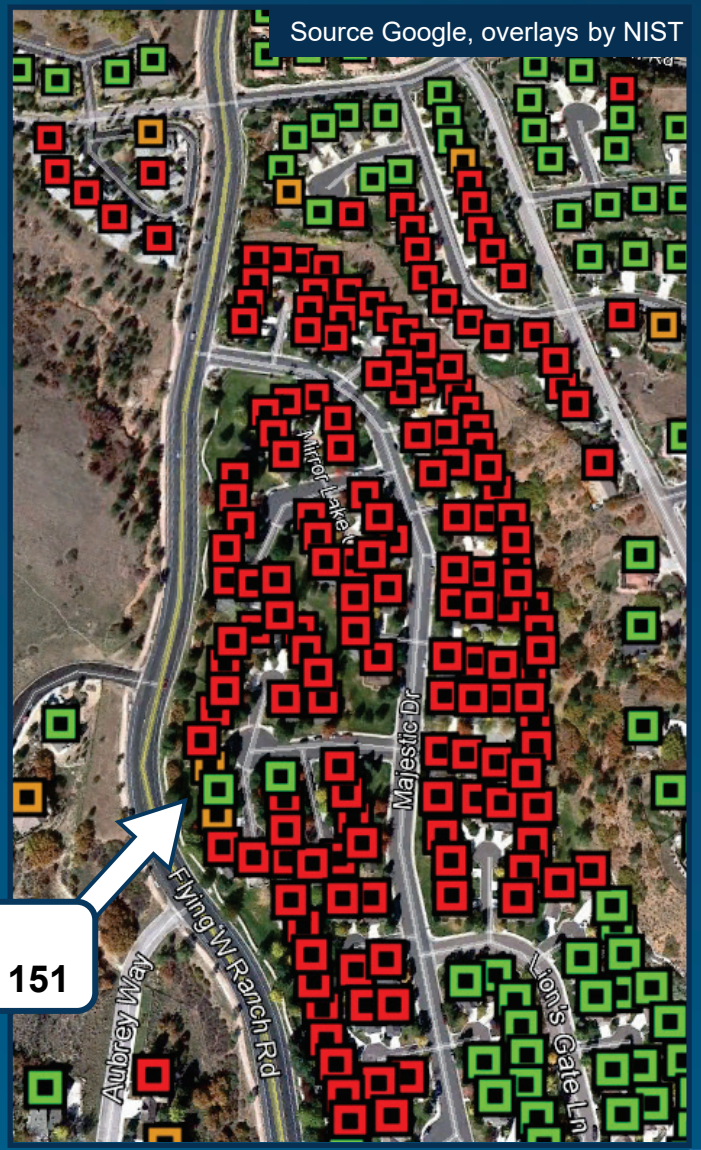
- Lack of judicious protocols for post-fire data collection:
  - Can lead to loss of data
  - Reduce overall quality
- Rapid WUI post-fire assessments:
  - Record all damage and destruction
  - Aid in identifying construction vulnerabilities



- Destroyed
- Damaged
- Undamaged

Exposure – Drivers

- Fuels
  - Vegetative (wildland and ornamental)
  - Non-vegetative (structural, vehicular, outbuildings)
- Terrain
  - Flat, sloped, canyon
  - Orientation of topographical feature
- Weather
  - Local wind
  - Moisture (fuel)

Exposure – Impacts

- Rapid WUI Fire Spread
  - Simultaneous multiple ignitions
  - Compressed evacuation
  - Harder to contain
  - Higher fire fighter exposure
  - Increased property losses

Exposure – Defensible Space Limitations

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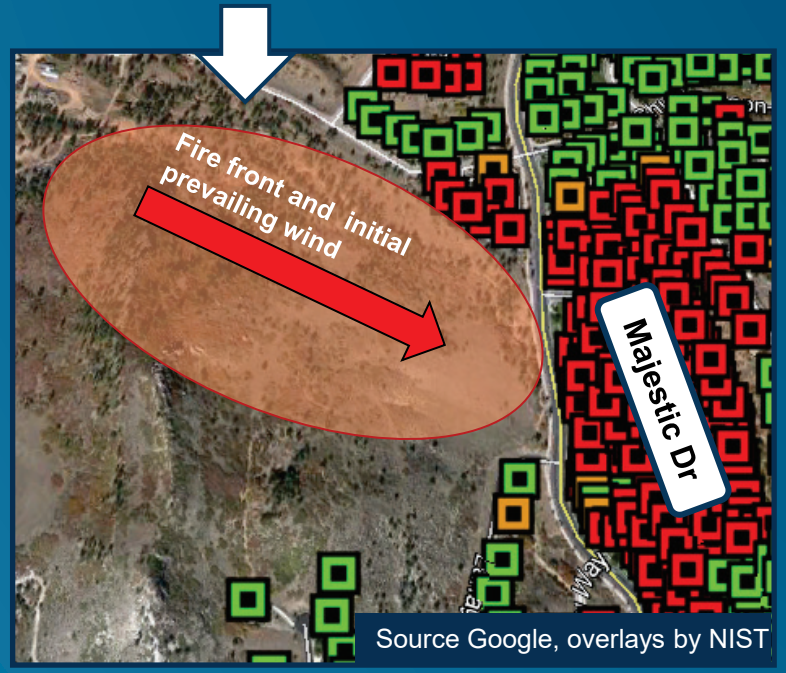
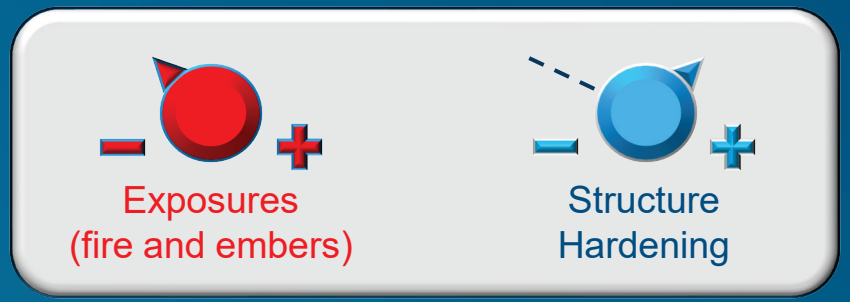
Current state of knowledge does not adequately consider:

- Defensibility from structure-to-structure fire spread
- Defensibility from dangerous topographic configurations



Addressing WUI Problem

1. Exposure Mitigation – Harden Target
   - Hardening structures and community
     - Design & materials (R11, R12, R13)
     - Codes and standards (R10)
2. Exposure Mitigation – Attenuate Source
   - Fuel treatments
     - External and internal to community (R5, R6, R7, R8, R9)



Addressing WUI Problem

3. Improve WUI Specific Response

Firefighting

- Tactics and SOPs (R1, R2, R3, R4)
- Training (R1)

Notification and Evacuation Preparedness

- Public education
- Pre-planning
- Training exercise

Waldo Summary

- WUI fires different from wildland or urban fires
  - Time scale
  - Ignition rates
  - Cascading ignition
- Waldo defensive actions – very effective
  - Saving structures
  - Containment
- Addressing WUI problem
  - Increase ignition resistance (Harden Target)
  - Reduce exposures (Source)
  - Improve WUI-specific response

Waldo Fire Acknowledgments

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208 Technical Discussions

City of Colorado Springs: Colorado Springs Fire Marshall Lacey, Colorado Spring Chief Dubay, Colorado Springs Fire Protection Engineer Smith, and Colorado Springs Audio Visual Specialist Schopper, Colorado Springs Utilities and Colorado Springs Police Department.

First Responders:
Colorado Springs Fire Department, Boone Fire Department, Broadmoor Fire Protection District, Calhan Fire Department, Cimarron Hills Fire Department, Colorado Springs Police Department, Colorado Springs Utilities Wildland Fire Team, Denver Fire Department, Denver Fire Station #5, Denver Fire Station#7, Denver Fire Station #8, Denver Fire Station #21, Denver Fire Station #28, El Paso County Sheriff Department, El Paso county Wildfire Suppression Team, Falcon Fire Department, Fountain Fire Department, Hanover Fire Department, HWY 115 Fire Department, Manitou Springs Fire Department, NE Teller County Fire Protection District- Woodland Park, Pikes Peak Community College Fire Science Engine, Pueblo County Sheriff Brush Truck, Pueblo Fire Department, Pueblo Rural, Pueblo West Station 3, Rye Fire Department, Security Fire Department, West Metro Fire Protection District, West Park Fire, Wheat Ridge Fire Protection District . Additionally, the authors would like to acknowledge the following USFS teams: Tahoe National Forest Command, Tahoe E43, Tahoe E31, Tahoe E42, Tahoe E333, Tahoe E73, Plumas E21 (command), Plumas E330, Plumas E32, Plumas E35, Plumas E24, Plumas E11, El Dorado E14, El Dorado E64, El Dorado E65, El Dorado E334, Ukonom Hot Shots Command, Redding Hot Shots Command, USFS Division Supervisor Command and USFS Pueblo Office.

Mountain Shadows residents:
Provided images and critical firsthand accounts of the fire, as well as those who provided information on structural and parcel damage.

Contact

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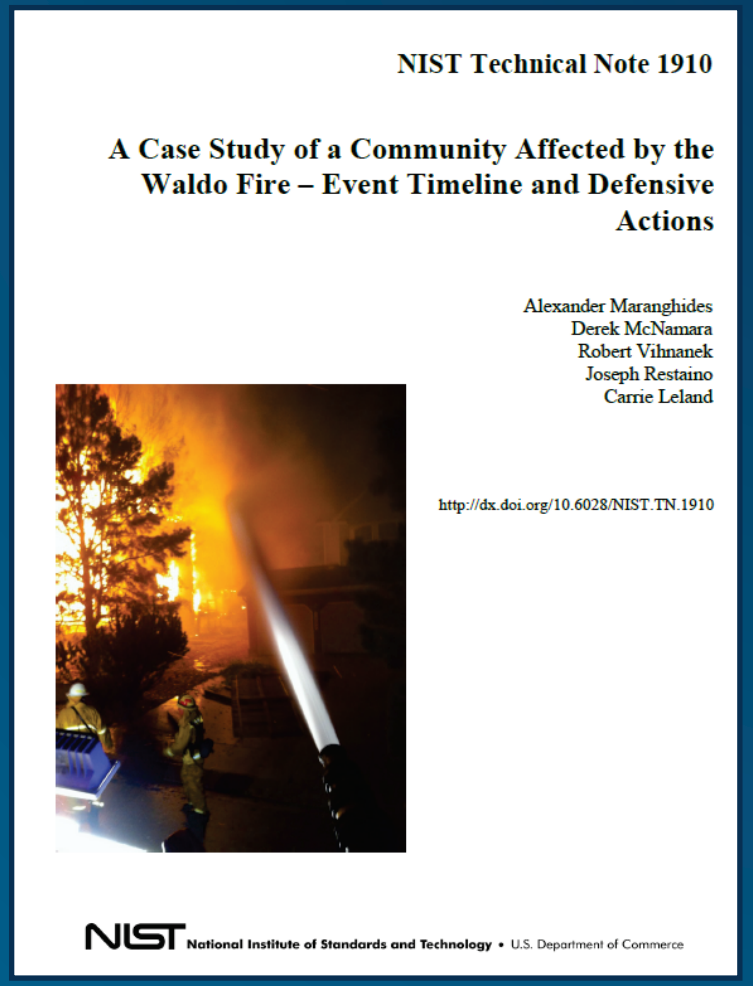

NIST Technical Note 1910
http://dx.doi.org/10.6028/NIST.TN.1910