2012 Waldo Fire
Wildland Urban Interface Case Study

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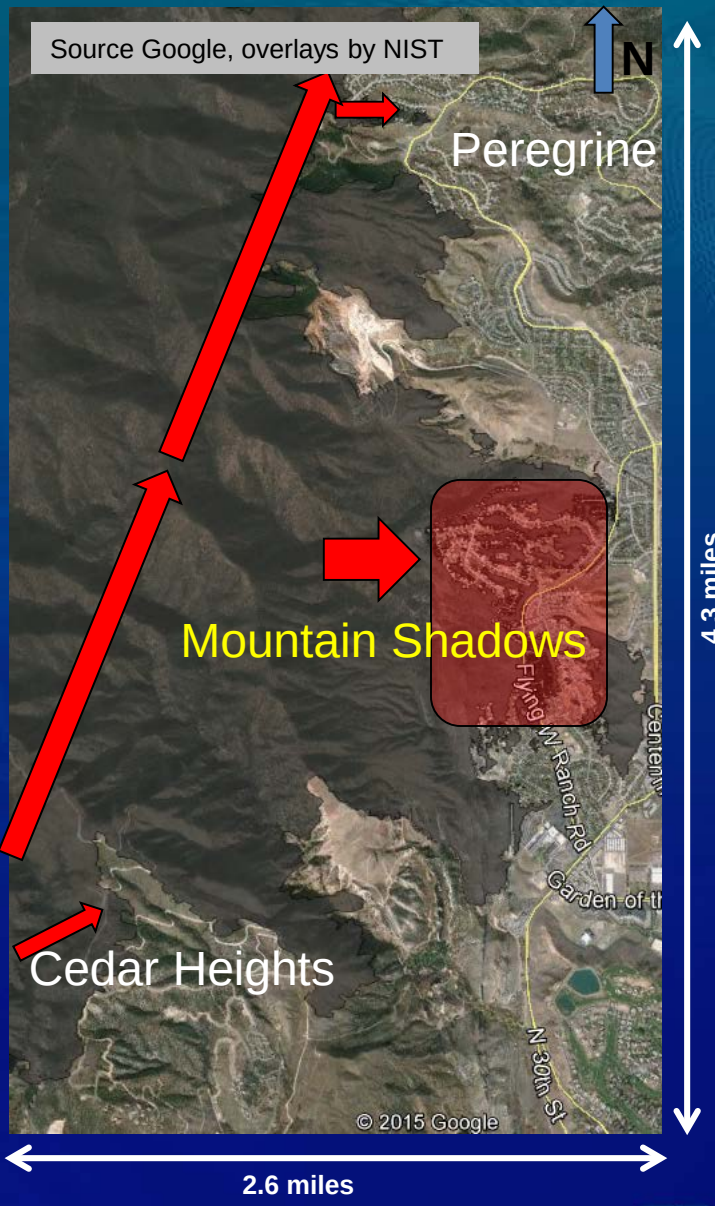
Photos courtesy of Colorado Spring Fire Department – Used with Permission

Investigation Findings

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

- 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.



Structure Ignitions

Thermal Radiation

Exposure

Flame Contact

Embers

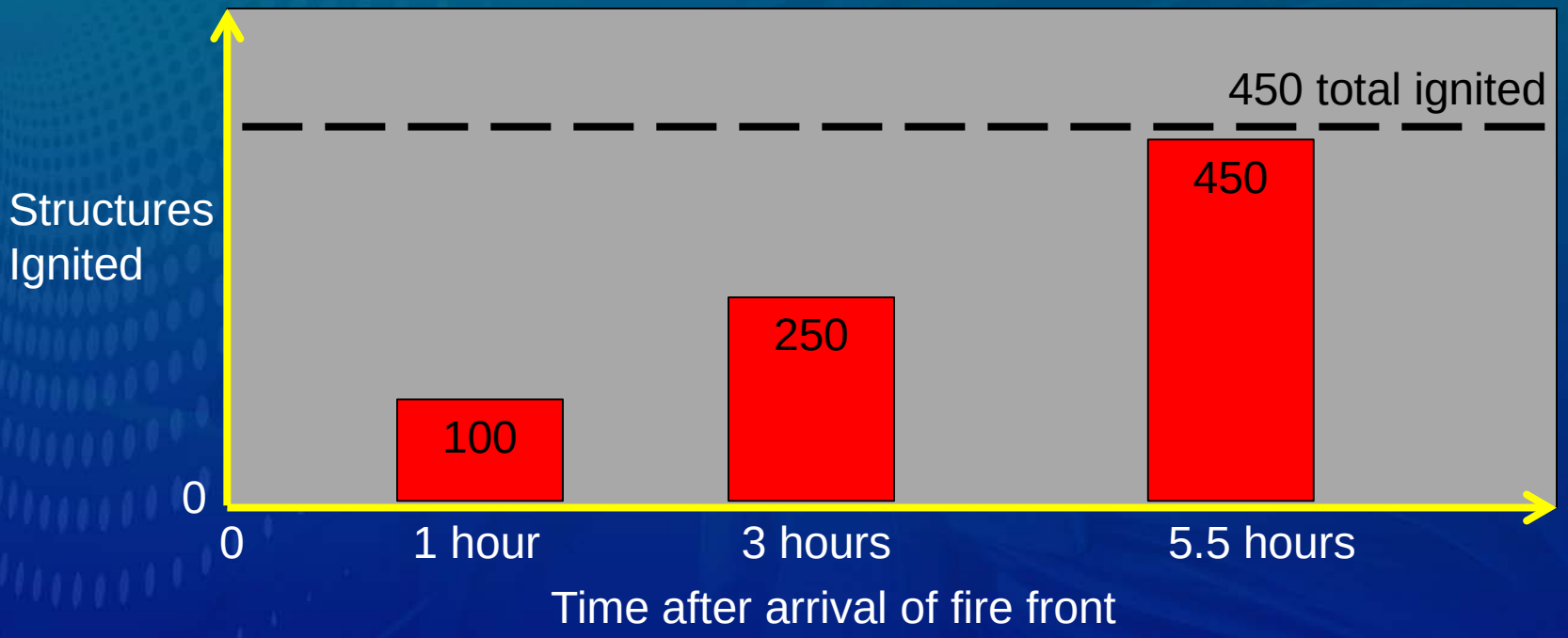
Recommendations Summary

Recommendation	*WUI Fires are Different*	*Defensive Actions*	*Exposure*
Defensive Actions			
1. Develop, plan, train and practice safe WUI SOPs	✓	✓	✓
2. Develop WUI response threshold based on exposure and structure vulnerabilities	✓	✓	✓
3. Identify ineffective/unsafe structure spatial arrangements for WUI firefighting	✓	✓	✓
4. Develop response plans for high density WUI areas	✓	✓	✓
Quantify Fire and Ember Exposure			
5. Update defensible space definitions		✓	✓
6. Characterize the relationships between spatial arrangement of houses and defensive actions		✓	✓
7. Quantity exposure factoring in fuels, topography, and local weather	✓		✓
8. Develop definitions for high and low fire/ember exposure areas			✓

Recommendations Summary

Recommendation	*WUI Fires are Different*	*Defensive Actions*	*Exposure*
Fuel Treatments			
9. Develop wildland fuel treatment standards	✓	✓	✓
10. Revise construction standards and test methods - fire and ember exposures from fuel treatments	✓		✓
Damage Assessments			
11. Document damage and destruction to the WUI environment with current technologies			✓
12. Develop protocols for ground/aerial imagery			✓
13. Develop protocols for WUI damaged structures			✓

WUI Fires are Different – Rapid Ignitions



~ 1 home/minute destroyed

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

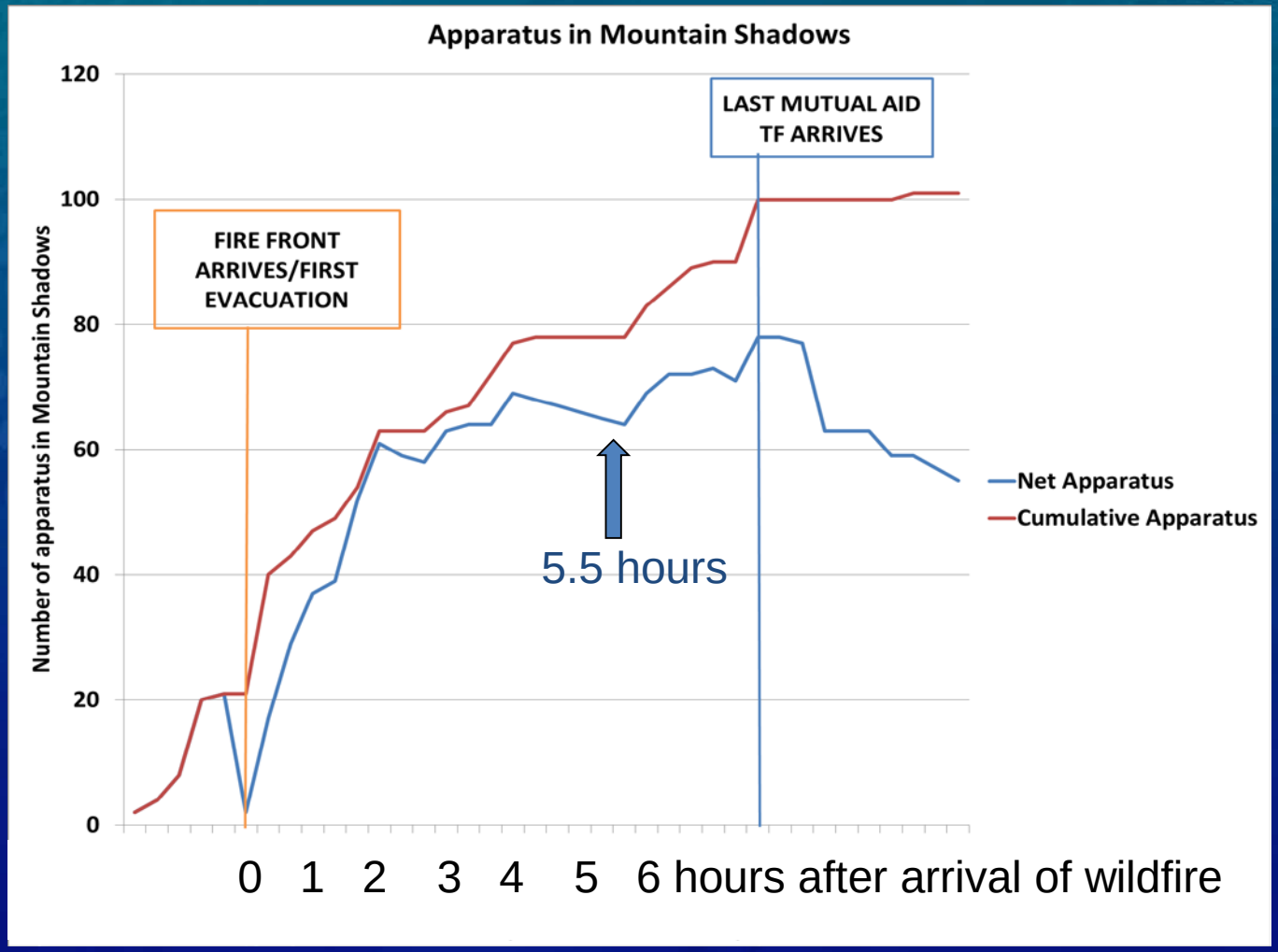
R1, R2, R3, R4

Short WUI Fire Event - over in 5 ½ hours

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

R1, R2, R3, R4

Short WUI Fire Event - over in 5 ½ hours



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

R1, R2, R3, R4

WUI Fires - Require Rapid Response

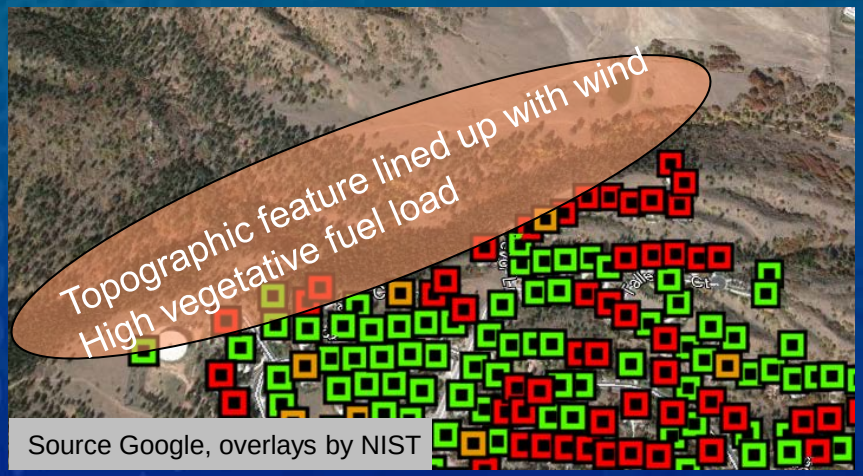
Urban Response	Urban Fire Extent of Damage	WUI Response	WUI Fire Extend of Damage	Wildfire Response	Wildland Fire Extent of Damage
One Fire Department Multiple Fire Stations	Room of origin (*seconds to minutes*)	Multiple Fire Departments and Jurisdictions ***Mutual Aid***	Interface boundary (*minutes 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

R1, R2, R3, R4, R7

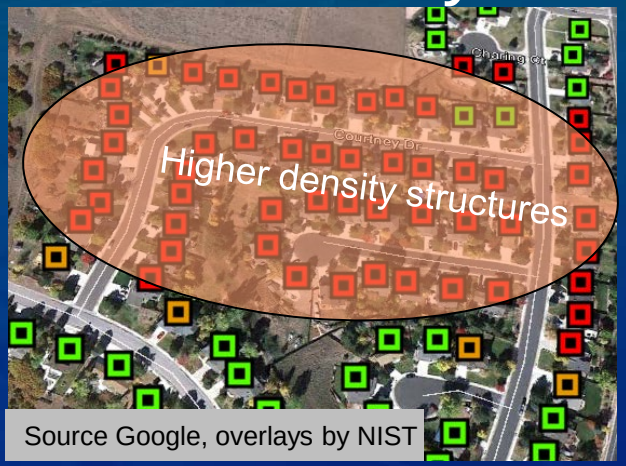
WUI Fires are Different – Community/Parcel/Building Exposures

Around Communities



Source Google, overlays by NIST

At Community Level



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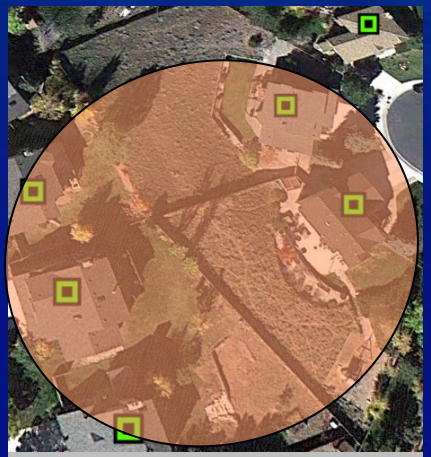


Source Google, overlays by NIST

At Parcel Level

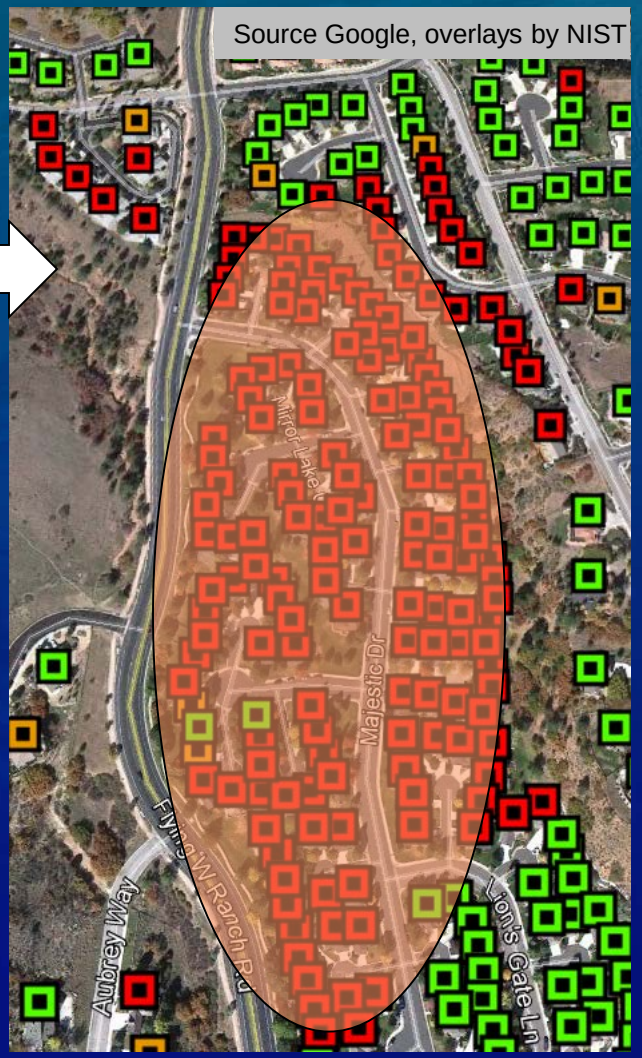
- Combustible decks
- Combustible fences
- Railroad ties
- Secondary buildings
- Re-entrant corners
- Readily ignitable roof coverings

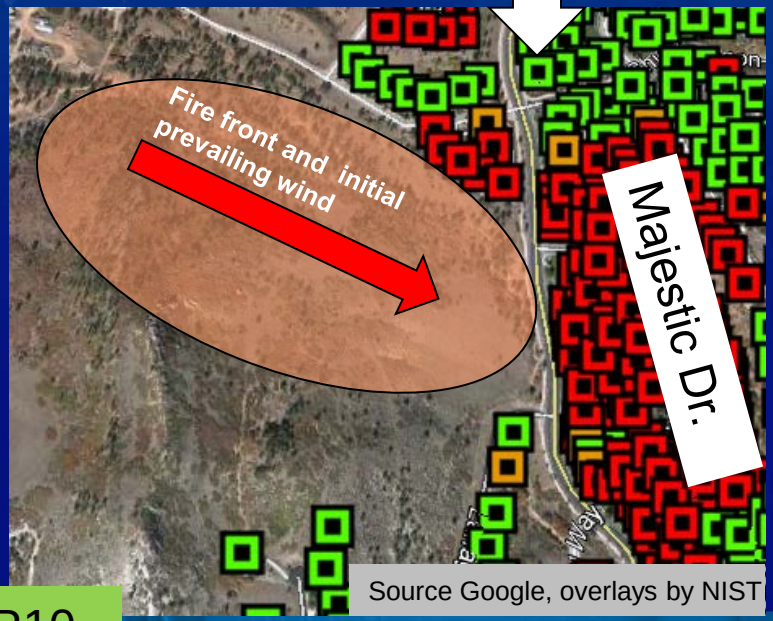
R1, R2, R3, R4, R7

Defensible Space Limitations

Current state of knowledge does not adequately consider:

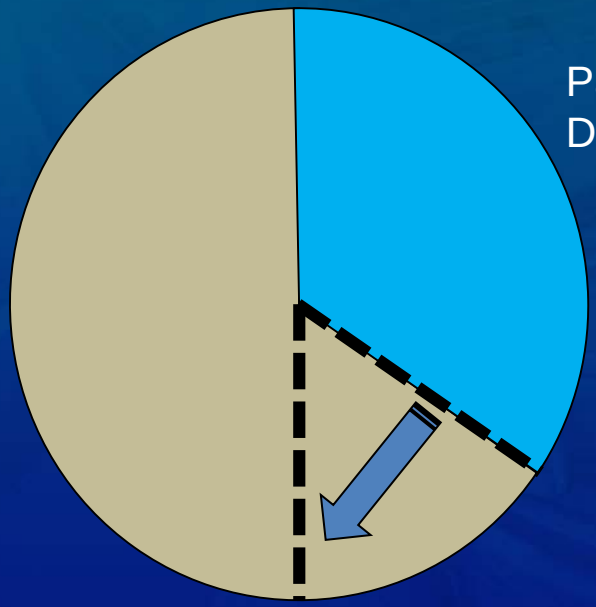
- Defensibility from structure to structure fire spread
- Defensibility from dangerous topographic configurations





R5, R9, R7, R10

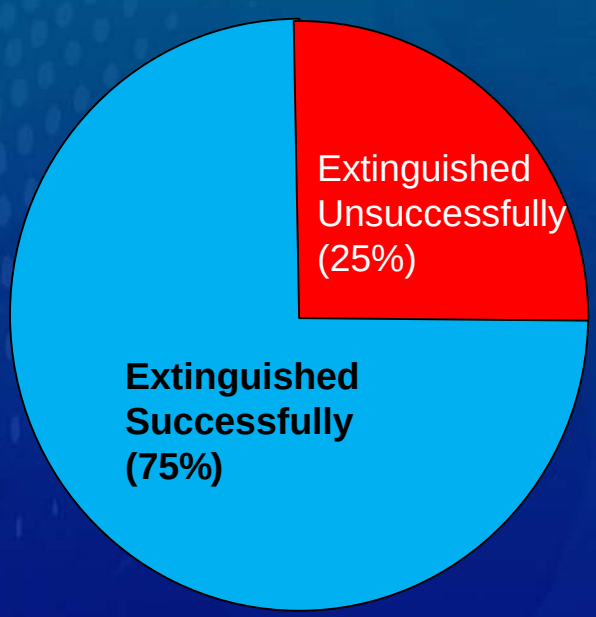
WUI Defensive Actions Were Effective – Impact Fire Outcome

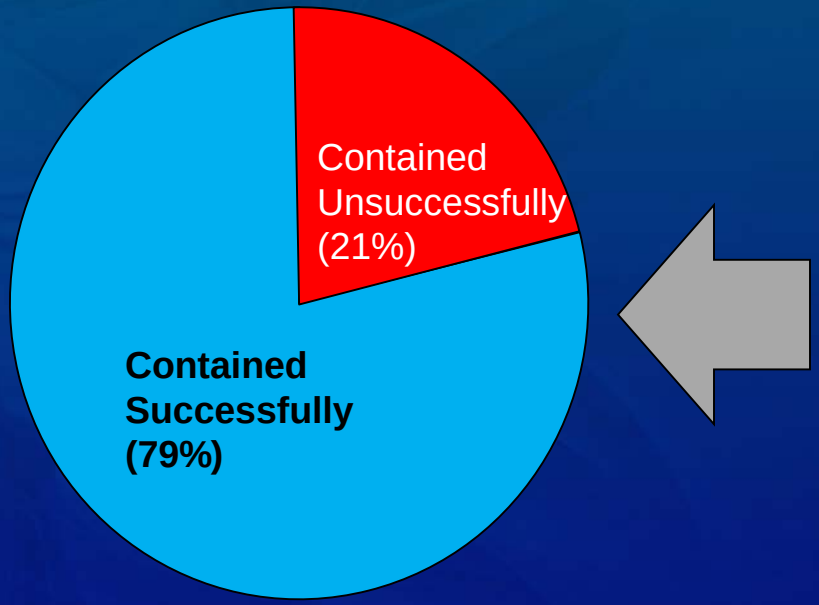


Defensive actions - alter WUI event severity and extent of loses

R1, R2, R3, R4

WUI Defensive Actions Were Effective





Structure saves

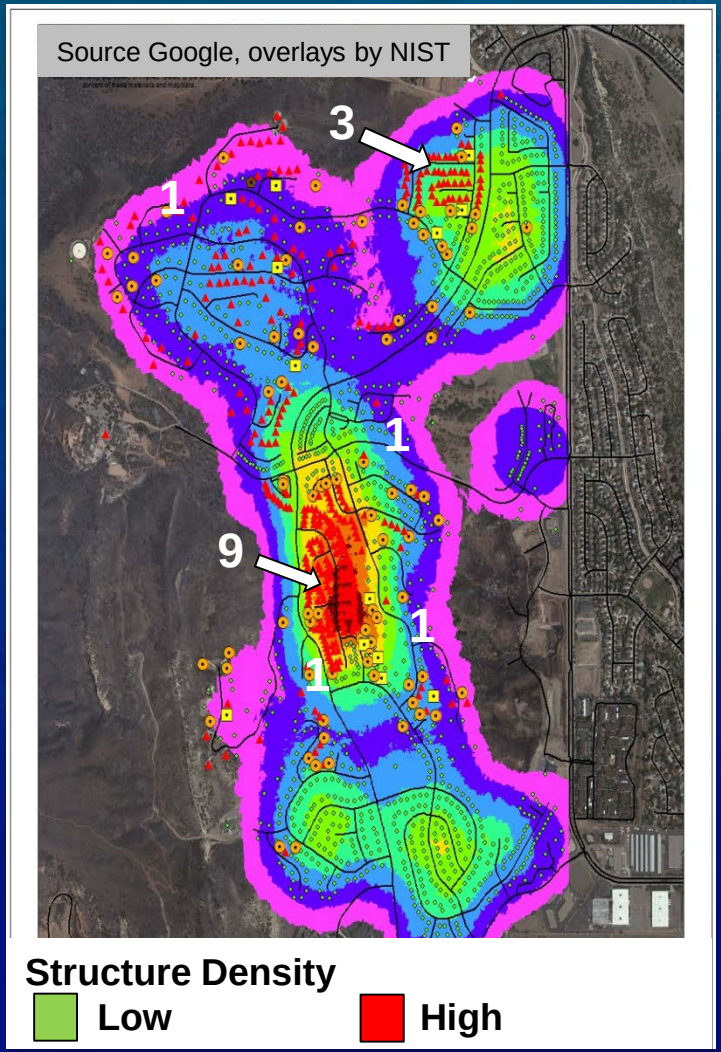
Prevent spreading to other structures

R1, R2, R3, R4

High Density Structures Dominate Containment Failures

12 out of 16 Structures in:

- High Fire Exposure
- High Density of Structures



Structure density impacted containment

R3, R6, R7

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

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)

3. Improve WUI Specific Response
   - Tactics and SOPs (R1, R2, R3, R4)
   - Training (R1)

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
  1. Increase Ignition Resistance (Harden Target)
  2. Reduce Exposures (Source)
  3. Improve WUI Specific Response

Waldo Fire Acknowledgments

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.

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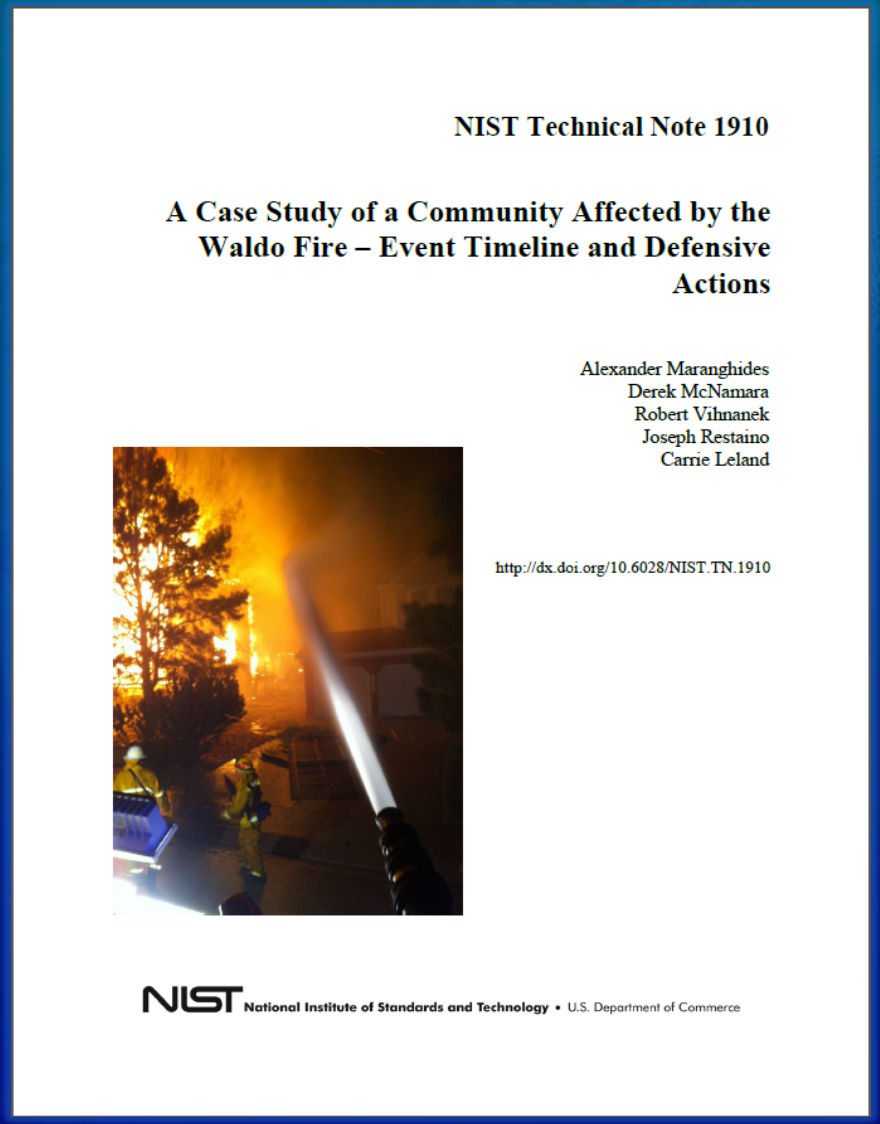

http://dx.doi.org/10.6028/NIST.TN.1910

Waldo Recommendation 1of 13

- Goal:
  - Enable rapid fire department response to WUI fires
- Need:
  - Develop, plan, train and practice SOPs, based on better understanding of exposure and structure vulnerabilities
  - SOPs need to account for responding, in the event of a specific WUI scenario, to both high and low exposure areas

Waldo Recommendations 2 of 13

- Goal:
  - Response time threshold for WUI fire situations - in the same way city fire departments have response thresholds for responding to building fires
- Need:
  - Develop response threshold based on increased understanding of exposure and structure vulnerabilities

Waldo Recommendation 3 of 13

- Goal:
  - First responder safety and efficiency
- Need:
  - Identify ineffective or unsafe structure spatial arrangements for WUI firefighting

Waldo Recommendations 4 of 13

- Goal:
  - WUI community fire resilience and reduce WUI fire loses
- Need:
  - Develop response plans for high density WUI areas, with the objective of fire not reaching these areas

Waldo Recommendations 5 of 13

- Goal:
  - Improved hazard identification
- Need:
  - Update defensible space definitions to emphasize:
    1. That the main desired result is the ability for first responders to defend locations
    2. Recognize hazards of primary structures and dangerous configurations of topography and fuels outside the home ignition zone (HIZ)

Waldo Recommendations 6 of 13

- Goal:
  - Improve fire fighting effectiveness
- Need:
  - Conduct additional research to fully characterize the relationships between the spatial arrangement of houses and defensive action

Waldo Recommendations 7 of 13

- Goal:
  - Quantify WUI hazards across different scales
- Need:
  - Quantity WUI hazards, factoring in fuels, topography, and local weather
  - Fuels need to include wildland fuels and structural/residential fuels such as wood roofs, fences and combustible decks.

Waldo Recommendations 8 of 13

- Goal:
  - Quantity fire and ember exposures at he WUI
- Need:
  - Develop a better understanding of exposure and structure vulnerabilities
  - Develop definitions for high and low fire and ember exposure areas

Waldo Recommendations 9 of 13

- Goal:
  - Enhance fuel treatments effectiveness
- Need:
  - Develop wildland fuel treatment standards
  - Quantify exposure reduction for different topographical and weather conditions

Waldo Recommendations 10 of 13

- Goal:
  - Improve WUI community fire resilience and reduce WUI fire loses
- Need:
  - Construction standards and test methods need to capture representative fire and ember exposures from fuel treatments

Waldo Recommendations 11 of 13

- Goal:
  - Effectiveness of rapid damage assessments
- Need:
  - Document damage and destruction to the WUI environment with current technologies and comprehensive methods for documentation

Waldo Recommendations 12 of 13

- Goal:
  - Documentation of WUI events
- Action:
  - Develop protocols for collection of ground and aerial imagery for pre-fire, during-fire and post-fire situations

Waldo Recommendations 13 of 13

- Goal:
  - Effectiveness of rapid damage assessments
- Need:
  - Develop protocols for collection of damage information in a WUI environment