Top Fire Research Needs for Wildland-Urban Interface Fire – Workshop Summary

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Wildland-Urban Interface (WUI) Fires

Introduction

Wildland Fires

- 100,000 wildland fires each year
- 7 million acres burned
- 2-3 % of fires spread into destructive WUI fires

WUI Communities

- at least 45 million structures
- over 70,000 communities at risk

WUI Community Fires

- About 3000 homes lost in “average” year
  - 3600 homes in Southern California 2003
  - 2200 homes in California 2007
  - 1600 homes in Texas 2011
  - 600 homes lost in Colorado 2012
- Total cost $14B (2009)

Why hasn't the WUI Fire Problem been solved?

- **Is it a issue of controlling wildfires?**
  - **Without wildfires – no WUI fires**
  - **Suppression or wildfire control approach**
- **Is it an issue of igniting a single home?**
  - **Single home ignitions – routinely handled by fire department**
- **Is it a issue of igniting multiple homes simultaneously?**
  - **Multiple ignitions and rapid fire spread overwhelm fire fighting resources**
  - **Need to prevent ignition of structures and limit fire spread**
  - **Structure ignition prevention approach**
- **Improve the fire resistance of WUI communities**

Hardening the WUI Communities

Focus on the structures within WUI communities

- at least 45 million structures
- over 70,000 communities at risk

Less focus on wildfire

- Less focus on 100,000 wildland fires
- Less focus on the 7 million acres burned
- Vegetation still the “source” term
- Understand the exposure the wildfire can represent

Preventing ignition of homes

- Quantifying the exposure
- Developing standard testing methods
- Incorporating exposure into building and fire codes

Why is it going to be difficult to solve?

WUI fire present unique challenges

- Exposure threats from multiple source
  brands, flame radiation & convection
- Wind & humidity, vegetation types, terrain
- Limited understanding of science of ignition & fire spread
- Gap in knowledge of what technologies/designs useful for fire
  protection
- No proven WUI fire fighting methods and no national best
  practices for WUI fire – wildland or structural fire fighters,
  but no wildland-urban fire fighters
- Limited science-based building and fire codes – communities being rebuilt without improved fire resistant materials or design
- Need to consider improved materials, and building, vegetation and community design

How do we address this problem with all its unique challenges or, basically, how do we harden WUI communities?

WUI Workshop

- Overviews by stakeholders
  - Brett Lacey – Waldo Canyon Fire
  - Dan Bailey – International Code Council
  - Hylton Haynes – National Fire Protection Association
  - Rick Swan – CalFIRE & IAFF
  - Kuma Sumathipala- American Wood Council
- Current Research
  - Steve Quarles – Institute for Business and Home Safety
  - Mark Dietenberger- US Forest Service
- Exposure, Exposure, & Exposure
  - Alex Maranghides – National Institute of Standards & Tech

WUI Fire Research Needs Workshop

Break out groups (Energetic Facilitators)

- Shortcomings of current WUI Fire mitigations methods
- Ignition prevention/limiting fire spread

- New codes, materials, designs, technologies and response
- Prioritize ideas within break-out group (use the dots)

- Report back ideas to workshop in prioritized order

- Roadmap worksheets
  - Identify approaches
  - Identify performance targets
  - Short term or long term

Table 3-1: Prioritized WUI Research Needs

Rank	Topics Areas	Votes
1.	Hardening of structures	(19)
2.	Specify performance standards and needs	(16)
3	Understand ignition phenomena	(13)
4.	Educate stakeholders on ignition prevention	(11)
4.	Improve tools for post-fire evaluation	(11)
4.	Unify and improve effectiveness of response teams	(11)
4.	Enhance fuels management	(11)
8.	Develop realistic and material-neutral test methods	(9)
8.	Codify Class A fire-rated roofs	(9)
10.	Strategically build greenbelts, parks, and defensible spaces into new developments	(8)
11.	Develop accelerated weathering protocol for materials and coatings	(7)
12.	Create simulation software to model trade-offs between vegetation and structure hardening options	(6)
13.	Develop and adopt classifications for combustible materials	(5)
13.	Produce new codes focused on both ignition and fire resistance	(5)
13.	Increase fire engine crew size to vastly increase efficiency	(5)
13.	Standardize defensible spaces in wildfire-prone states	(5)
17.	Research fire-resistive materials	(3)
18.	Organize social or local grassroots inspections and self-enforcement	(0)

NIST Workshop on WUI Fire Research Needs

Top Five WUI Research Needs

1) Harden building structures

2) Specify performance standards/needs

3) Understand ignition phenomena

4) Education

4) Fuels Management

4) Improved tools for post-fire evaluation

4) Attack of fires – improved effectiveness, resources, technology, develop standards for unified command

Figure 3-1: Hardening of Structures

A hardened building is one that can resist wildfire exposures including ember/firebrand, radiant heat, and direct flame contact. When home spacing is close, extended exposures to radiant heat and flames must be considered. An effective structure hardening program must have viable defensible space and a vegetation management component (parcel level and community). An effective community hardening program will consider existing defensible space (including topography) and building spacing.

Short- or Long-Term Priority

Both short and long term: Homes are an important financial investment for homeowners.

Major Tasks

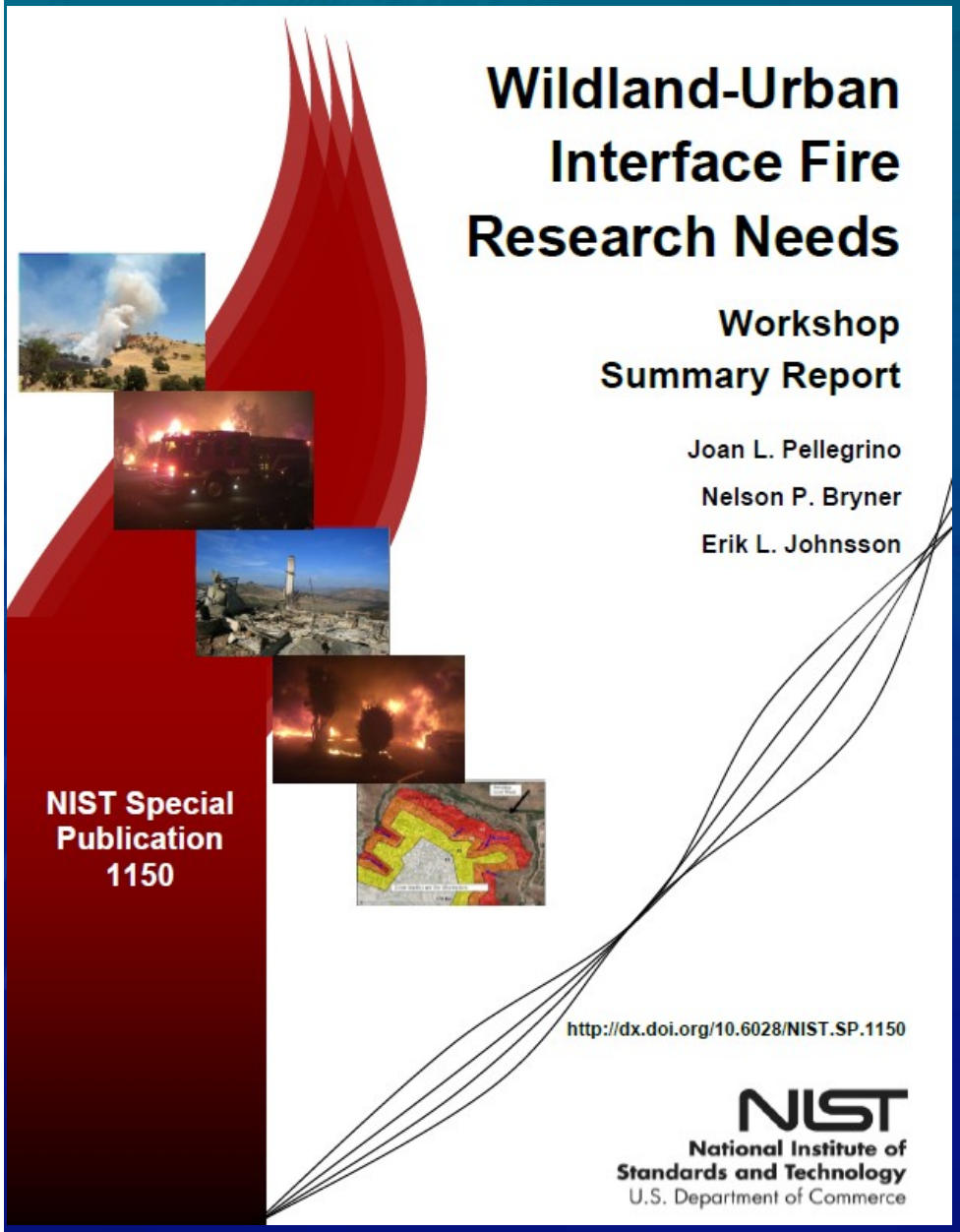
- Review existing documents related to hardening buildings (NFPA, Chapter 7A[CA], IWUIC [ICC], other research) for adequacy and deficiencies
- Review and evaluate adequacy of current defensible space requirements in minimizing radiant heat exposure and opportunity for flame contact exposure
- Separate mitigation issues specifically related to new versus existing homes
- Improve building, lot, and community design
- Enhance construction material

Major Milestones

- Conduct critical review of key publications: current codes, standards, and defensible space requirements (0 to 3 years)
- Define exposures (0 to 3 years)
- Slow propagation by improving new subdivision separation distances and greenbelts (0 to 3 years)
- Identify and collect baseline data on building ignition and fire spread in the community (0 to 3 years)
- Decrease ignition of lot vegetation by embers (0 to 3 years) and by flame (>3 years)
- Reduce ignition of building exterior by embers and flame (>3 years)

Performance Targets

- Reviewed building codes and standards
- Vetted homeowner document (for existing homes)
- Vetted new home or building document in use
- Educational materials in hands of end users
- Reduced building ignition by 25 % in 3 years; 50 % in 5 years
- Slowed propagation rate by 25 % in 3 years; 50 % in 5 years



Summary Report available on line at:

http://dx.doi.org/10.6028/NIST.SP.1150

Questions??

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Backup Slides –

In case of feisty audiences – break the glass to access

ICC Blue Ribbon Panel Report on WUI Fire 2008

- WUI Education
  - Federal, state, and local levels
- WUI Incentives
  - Promote greater economic initiatives in prevention, education, and mitigation
  - Explore national emergency response incentive program
- WUI Mitigation
  - Prioritize and distribute mitigation resources based on risk
  - Innovative research and design
  - Promote individual property owner responsibility
- WUI Regulation
  - Promote better integration of land-use planning, community development, CWPPs
  - Codes and ordinances to support local fire prevention
  - Research on effectiveness of local WUI ordinances
- WUI Fire Suppression
  - Cross-training structural FF
  - Cooperative fire suppression efforts
  - Support funding of existing, proven federal and state assistance

NFFF Second National Research Agenda

- Safe and reliable aircraft operations
  - Suppression & transport
- Respiratory hazards and smoke exposure
  - Smoke and particulate exposure
- Lack of standardized data and centralized database
  - Fatalities and injuries
- Level of threat due to changing conditions
  - Early detection of burnover
- Wildland fire fighting research dissemination
  - Central clearinghouse

NIST Workshop on WUI Fire Research Needs

- Harden building structures
- Specify performance standards/needs
- Understand ignition phenomena
- Education
- Fuels Management
- Improved tools for post-fire evaluation
- Attack of fires – improved effectiveness, resources, technology, develop standards for unified command
- Test methods that represent realistic problems
- Codify Class A fire-rated roofs as a system, to include vulnerabilities of complex roofs
- Increase fire engine crew size to vastly increase efficiency
- Develop simulation software to show homeowners tradeoffs between vegetation & structure hardening options

NIST Workshop on WUI Fire Research Needs

- Strategically build greenbelts, parks, defensible spaces into new developments
- Standardize defensible spaces in high wildfire-prone states
- Develop accelerated weathering protocol for materials & coatings
- Test methods that represent realistic problems, e.g., performance based and material neutral
- New codes focused on both ignition and fire resistance
- Research fire resistive materials
- Social/local grassroots
  inspections and self enforcement

WUI Fire Exposure Scale – Maranghides (NIST) & Mell (USFS)

- **Exposure Quantification**
  - *Earthquake: Richter energy scale* *(1935)*
  - *Hurricane: Saffir-Simpson intensity scale* *(1971)*
  - *Tornado: Fujita-Pearson intensity scale* *(1971)*
  - *WUI Fire Hazard Scale: Exposure intensity scale* *(2012)*

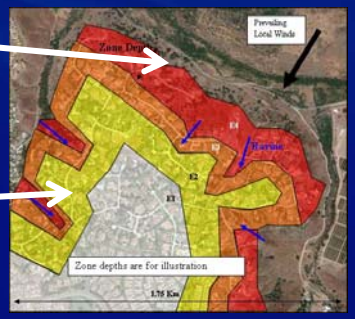
- WUI Fire Exposure - *involves fuel, weather, & topography*

- Use exposure to create representative test methods
- Use test methods to update codes and standards
- Reduction of WUI losses

Cedar Fire, California 2003

Flame Contact & Thermal Radiation

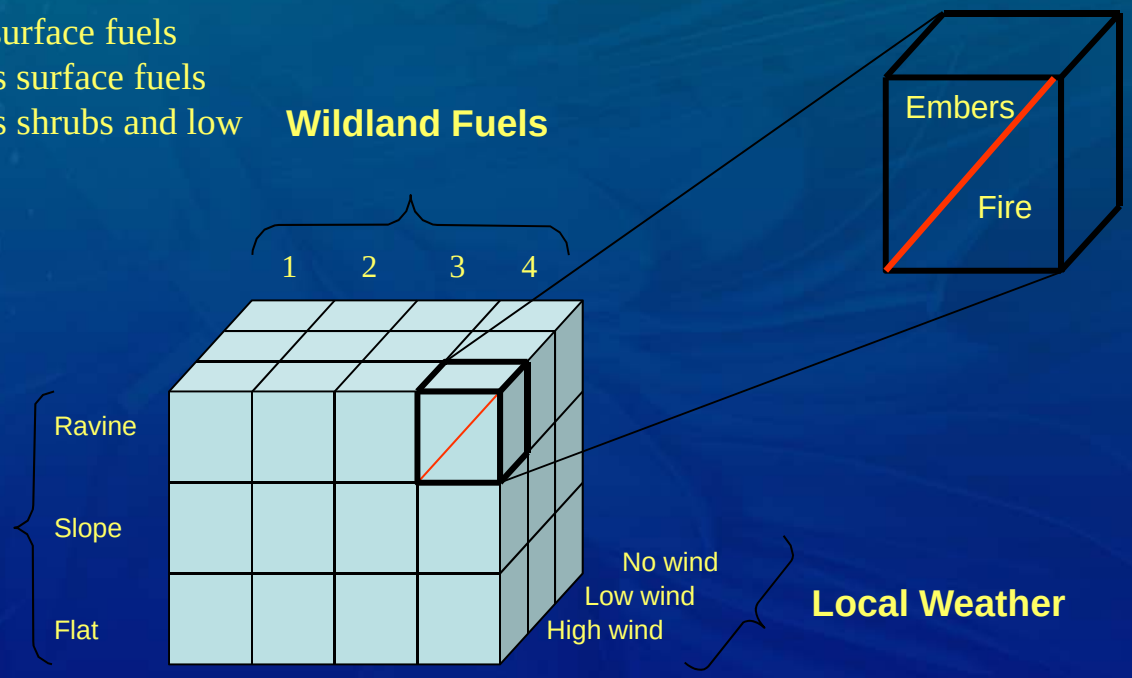
Firebrands



Witch Creek Fire, California 2007

Capturing Exposure from Wildland Fuels*

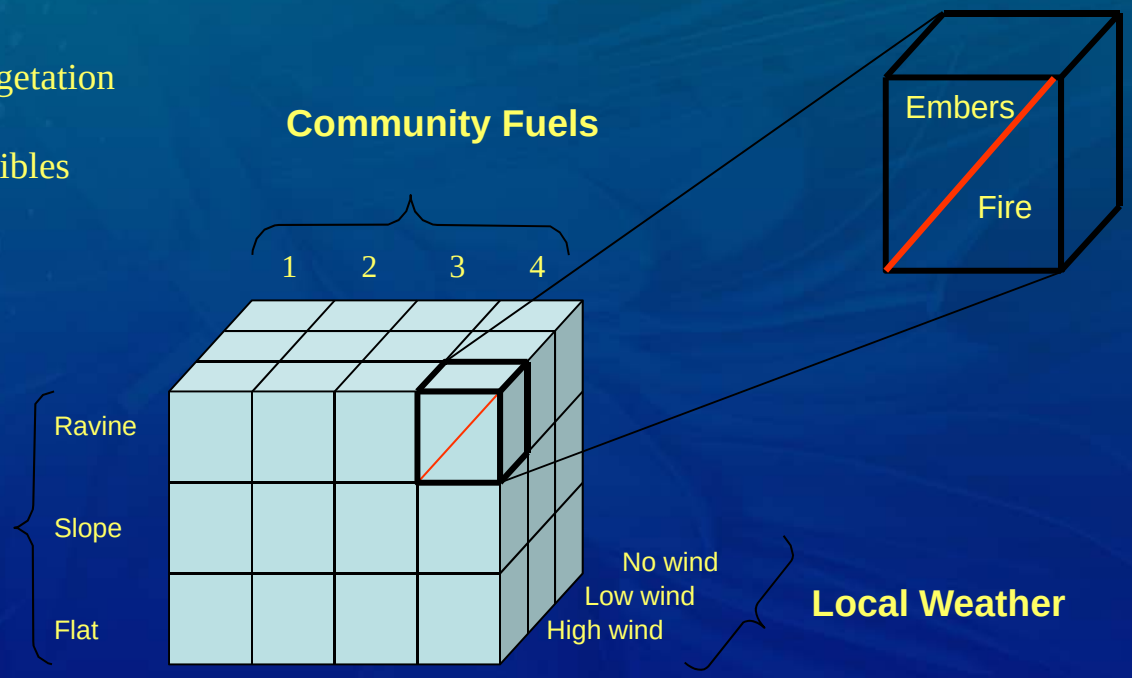
1: homogeneous surface fuels
2: inhomogeneous surface fuels
3: inhomogeneous shrubs and low vegetation
4: canopied forest



* Similar approach is used for addressing threat from community fuels

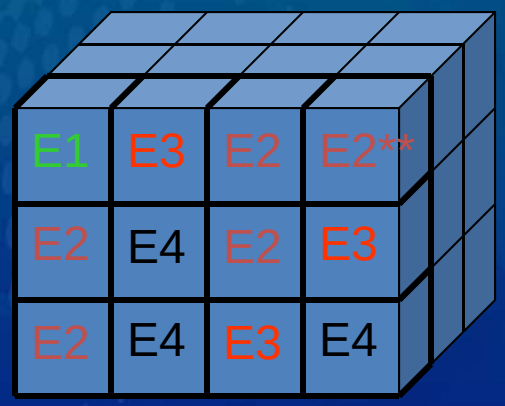
Capturing Exposure from Community Fuels

1: Structure
2: Ornamental Vegetation
3: Cars
4: Other Combustibles



Exposure Scale

Variables Matrix



Exposure Scale*

E4 – Most Severe

E3

E2

E1

E0 – No WUI Exposure

* Exposure is calculated as a function of distance from fuels/topographical features

** Exposure rating for each scenario represents the highest of the two: fire and embers

Reducing Loses
*Coupling Exposure to Construction**

Exposure Scale		**Building Construction Scale**
E4 - Most Severe		
E3	⟷	E3 – Most Resistive
E2	⟷	E2
E1	⟷	E1
E0 – No WUI Exposure	⟷	E0 – Unrestricted** Construction

* Building and landscaping – construction and maintenance

** Unrestricted only with respect to WUI exposure

Representative E-Zone Fuel, Terrain and/or Local Weather Characteristics

E-Zone	Ember Exposure	Fuel	Terrain	Local weather
E1	no ember exposure	light fuels- wet environment	flat terrain	- low or moderate humidity - light winds
E2	minimal ember exposure	light fuel loading	moderate slope	- low humidity - intermediate winds
E3	significant ember exposure	intermediate fuel loading	moderate slope	- low humidity - strong winds
E4	extensive ember exposure	- dry flash[1] fuels - high fuel loading	- steep slope - chimneys	- low humidity - strong winds

[1] **Flash Fuels:** Fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, that ignite readily and are consumed rapidly when dry. Also called fine fuels. Source: Glossary of Wildland Fire Terminology, National Wildfire Coordinating Group, PMS 205, October 2006

A New Community Design Using the WUI Hazard Scale

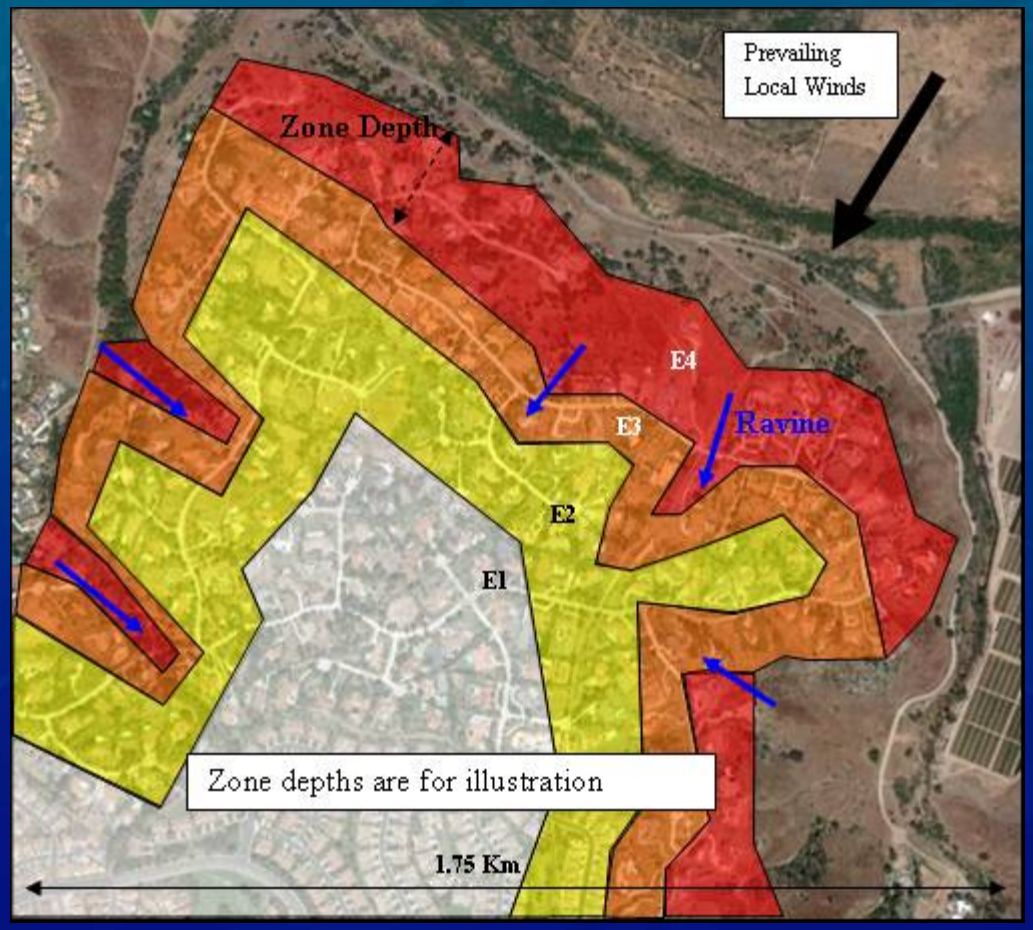


Illustration of Wildland Ember Exposure on Community