

# Wildfire risk and treatment effectiveness of protecting highly valued resources and assets with fuels management



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# Project Goals

## SCIENCE

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- Expand the knowledge base regarding risk-based assessment of fuel treatment effectiveness
- Better establish linkages at the nexus of fuel treatment planning, suppression response planning, and wildfire incident decision making

## DELIVERY

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Yield significant improvements in:

- How fuel treatments are designed and implemented
- How incident managers understand and respond to wildfire-treatment interactions

# Science Delivery



**Wildland Fire Management  
Research, Development & Application**  
*Integrating Science, Technology and Fire Management*



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**US Forest Service**

*Caring for the land and serving people*



**Fire & Aviation Management**

# Motivation

# Risk-Based Decision Support



WFSS: Wildland Fire Decision Support System

FSPRO RAVAR: Rapid Assessment of Values-at-Risk

## Zaca Fire, CA

4 August 2007 - T1\_E\_070803\_1\_Mh  
Major Values-at-Risk per  
FSPRO Fire Spread Probabilities:  
14 days as of 3 August 2007

- Fire Perimeter as of 3 August
- MODIS Burn 8 days
- 4 August
- 3 August
- Previous 6 days
- Past Fires 1994-2006

### FSPRO Fire Spread Probability

- > 80 %
- 60 - 80 %
- 40 - 60 %
- 20 - 40 %
- 5 - 20 %
- 1 - 5 %
- < 1 %

### FSPRO Spread Barriers

- RAWS Stations
- Building Clusters - Ventura Co.
- Improved Parcels - Santa Barbara Co.

### Water Features

- Water: Dams > 100ft
- Water Supply Intakes
- Water Treatment Plants
- Water Pipeline - Aqueduct - Canal

### Powerlines

- Industrial Plant
- Power Pylon
- Communication Towers

### Oil & Gas Transmission Lines

- Airports
- Airport Runways
- Police Stations
- Hospitals
- Fire Stations
- Schools
- HAZMAT: Mines
- HAZMAT: Superfund Sites
- HAZMAT: Hazardous Waste
- Other Landmarks
- Interstates
- Major Roads
- Railways
- County Boundary

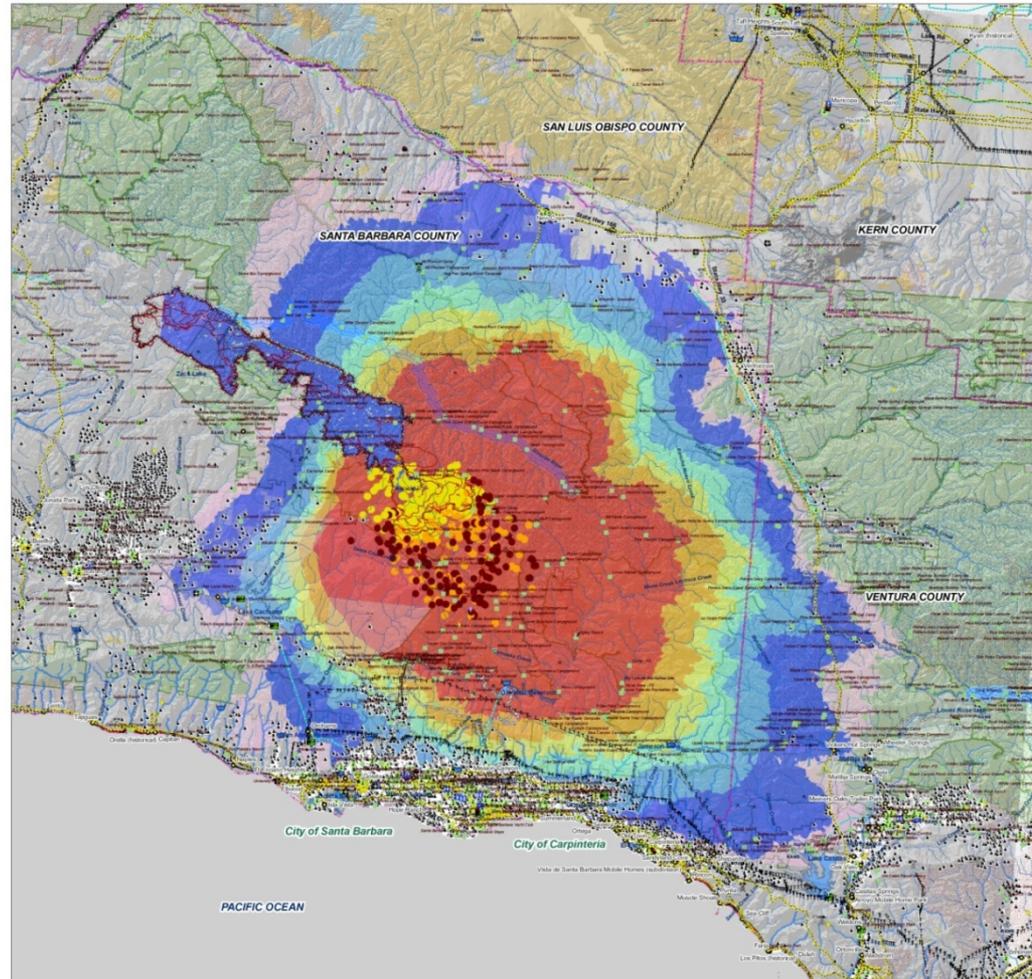
### Jurisdiction

- Private
- State
- BLM
- BCR
- USFS
- Inventoried Roadless
- Designated Wilderness
- WNI-Scenic-Rec Rivers
- Building Clusters - Santa Barbara Co.

\*Building Clusters represent the center of parcels where county assessor records indicate taxable improvements are present. One or more structures and other improvements may exist proximate to these point locations.

CAUTION-Defer to air photos or local knowledge for exact structure and other feature locations.

Prepared by Kevin Hoyle (8671) for USFS (8660) Inventory Science Lab, Missoula - 400.333.1107 - kahoyle@fs.fed.us



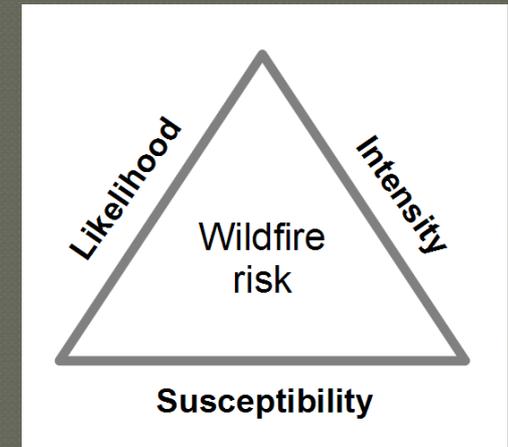
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0 5 10 20 Miles

# Risk-informed fuels management

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- How do fuel treatments:
  - affect spatial patterns of wildfire likelihood and intensity?
  - affect the exposure of highly valued resources and assets (HVRAs) to risk factors?
  - affect the response of HVRAs to wildfire?



# Analyzing treatment success

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- How does fuel treatment effectiveness vary with:
  - Geographic characteristics
  - Treatment type & age
  - Fire weather conditions
  - Spatiotemporal wildfire-treatment interactions
  - Suppression operations

# Basic Approach

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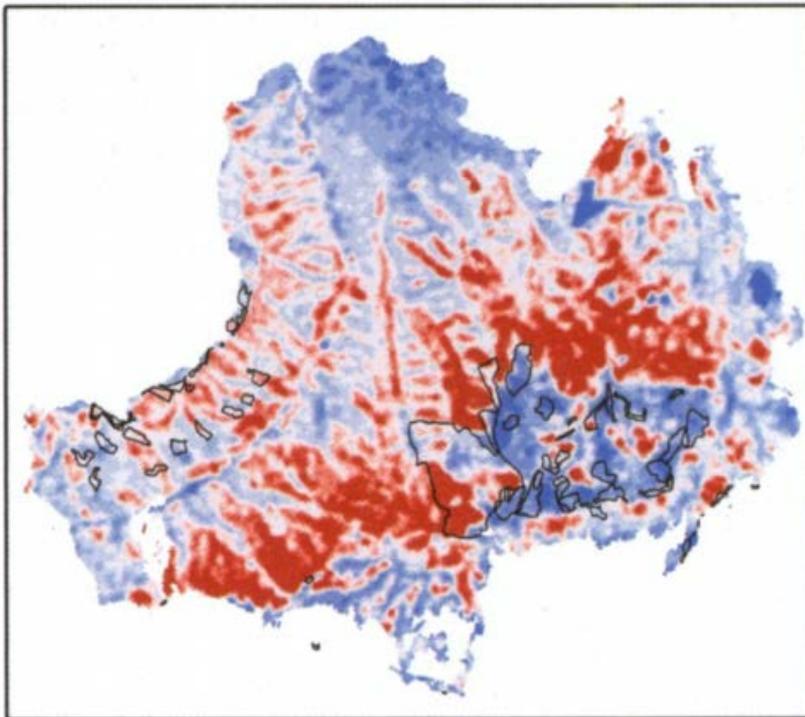
- Earth Observation data
  - Landsat: burn severity & fuels
  - MODIS: active fire detection & progression maps
- Stochastic wildfire simulation
- Geospatial analysis
- Exposure & risk assessment

# E.O. Data >> Treatment Effects

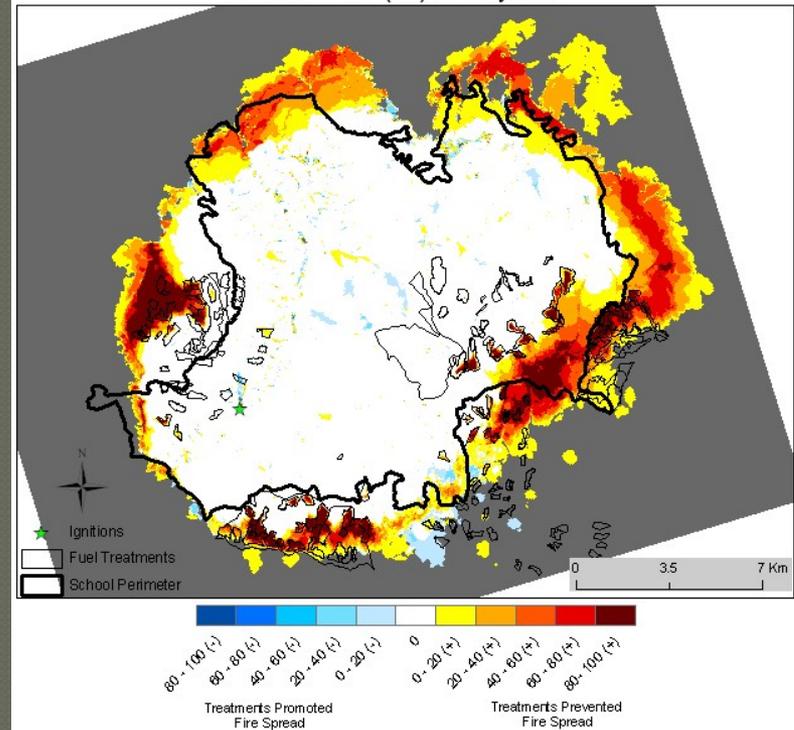
ON-SITE:  
SEVERITY

OFF-SITE:  
PROBABILITY & INTENSITY

B) School fire

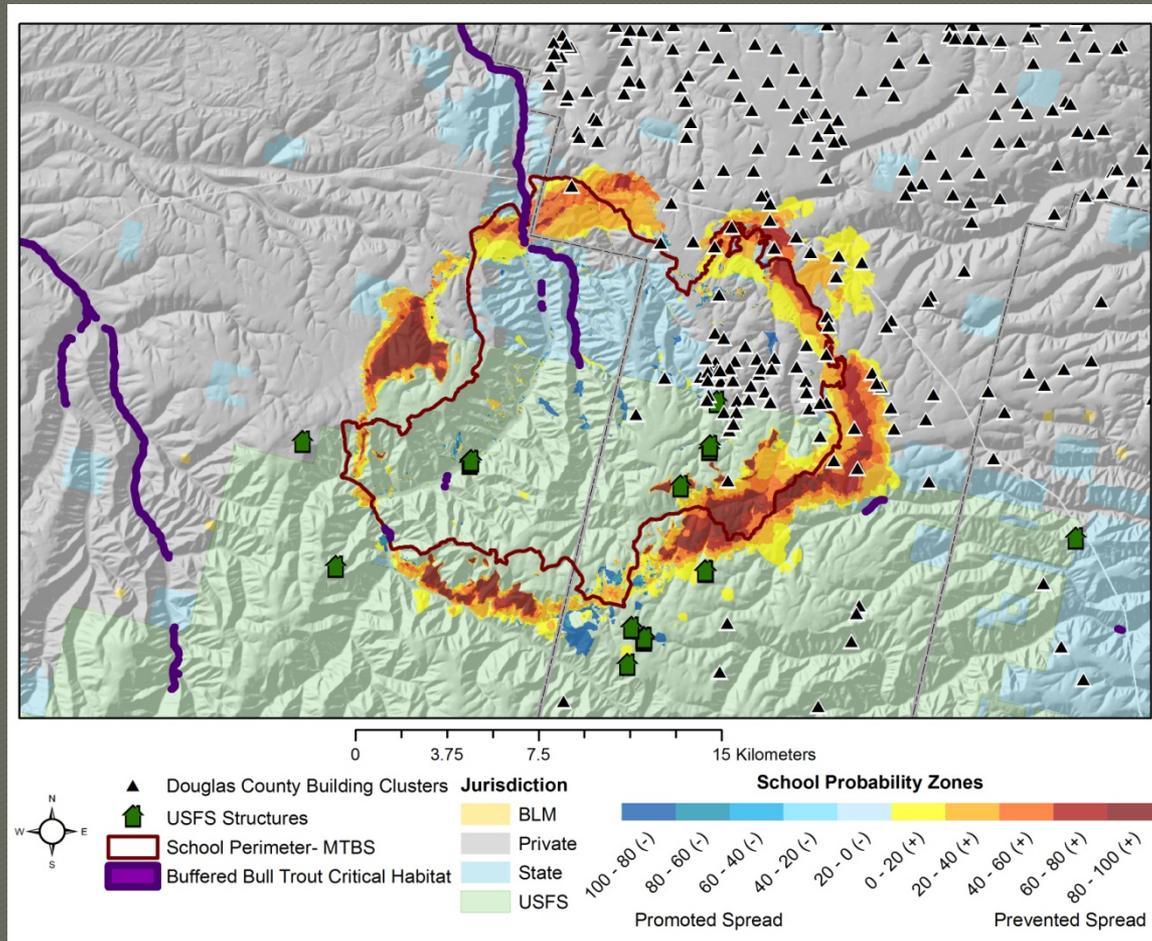


School Fire (f2) Analysis1

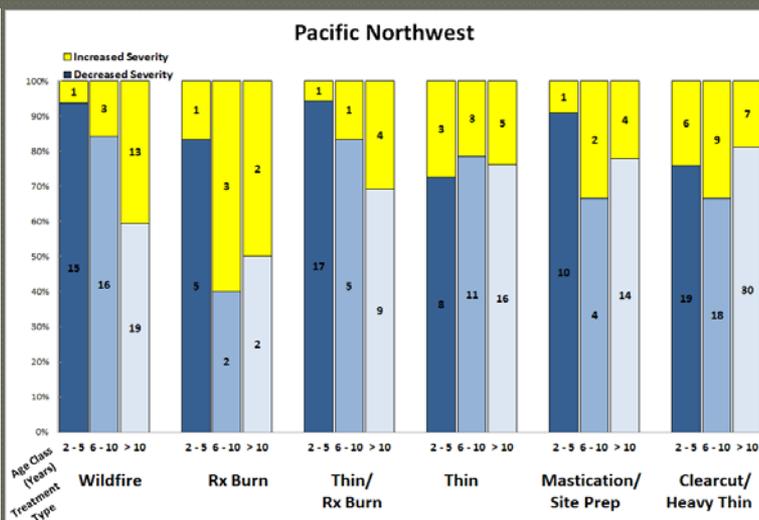
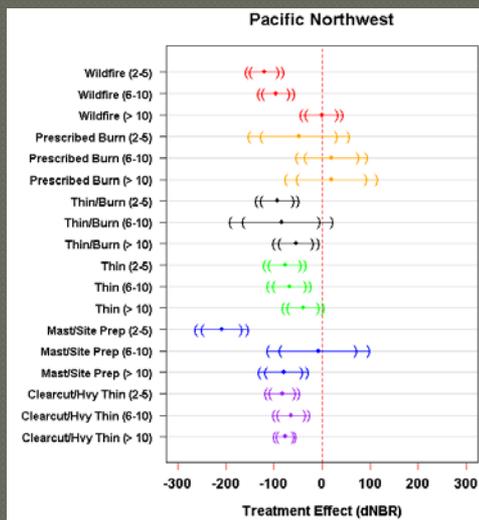


Map Created on August 5, 2010 (FTEUS)

# Fuel Treatments & Exposure

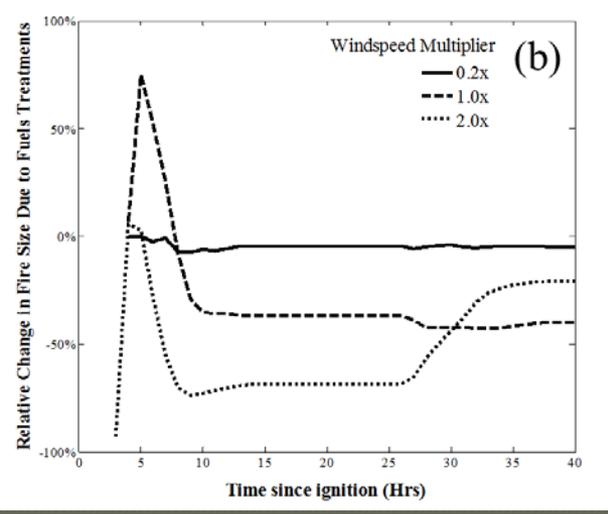
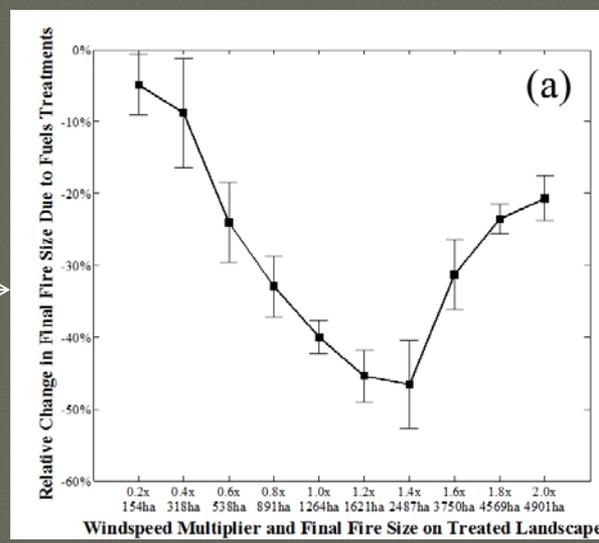


# Results: Fire Behavior



How do treatments of varying types and ages affect burn severity?

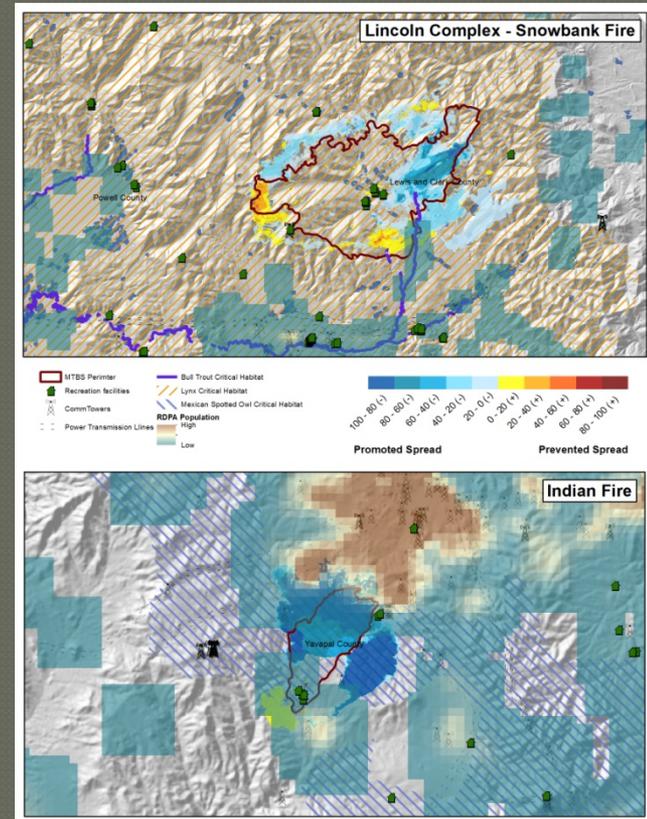
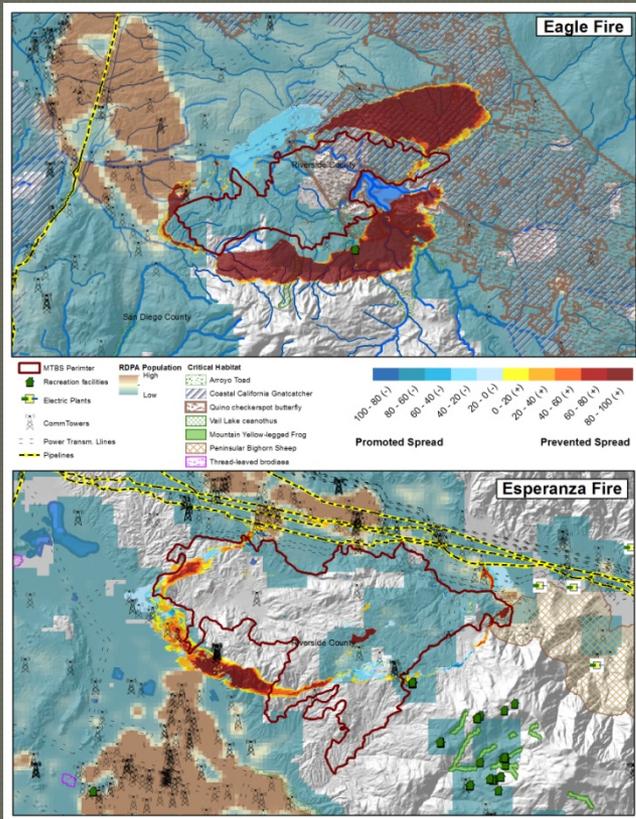
How sensitive are fuel treatment impacts on fire size to different wind speeds?



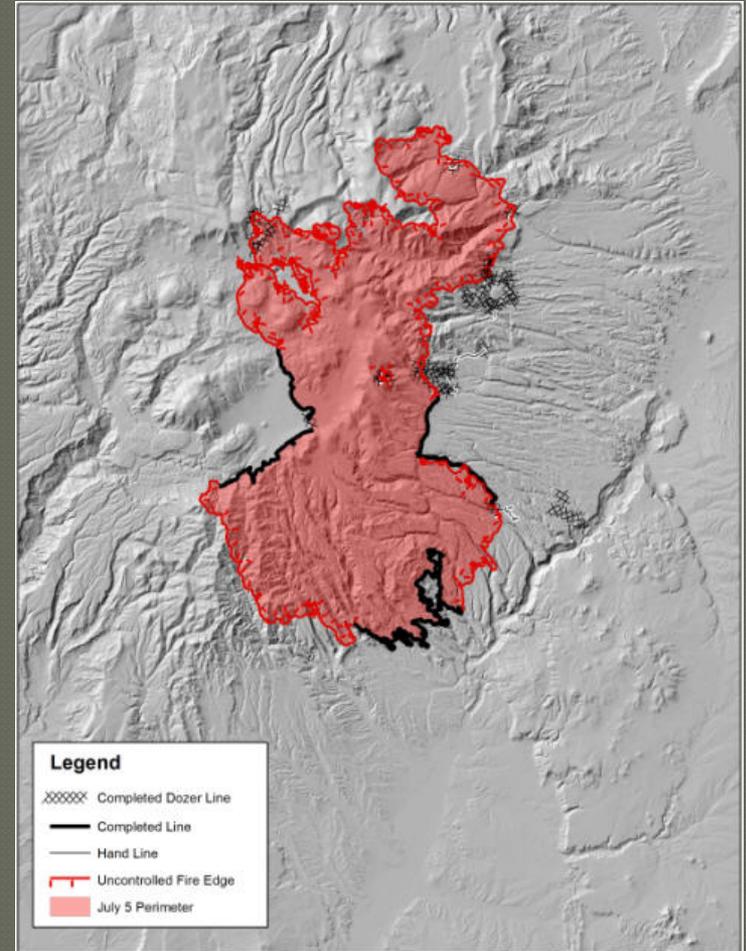
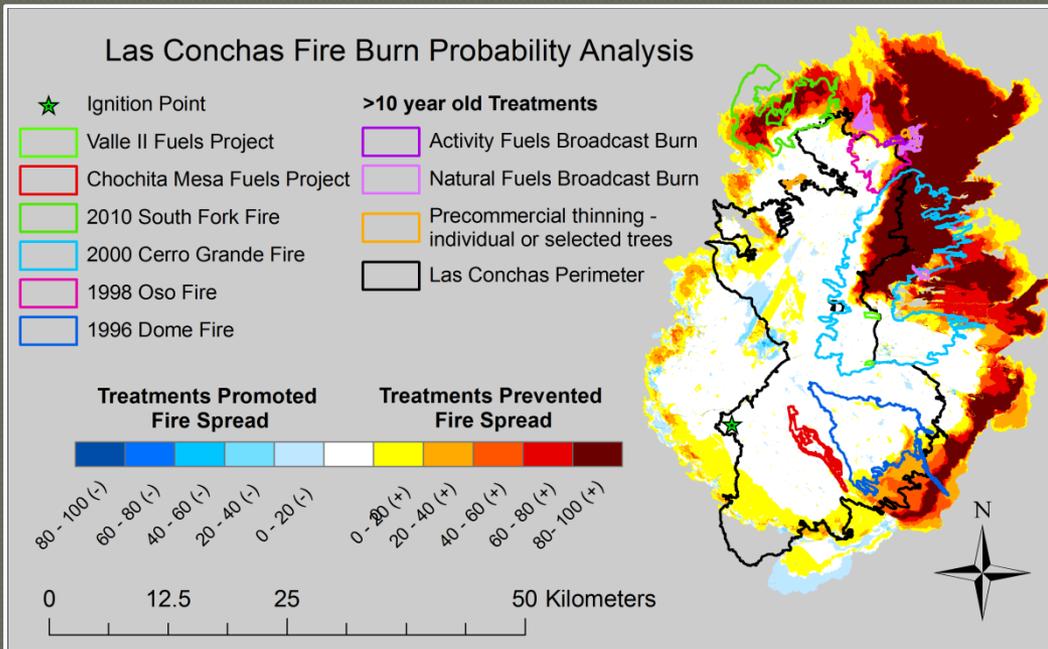
# Results: HVRA Exposure

## PREVENTED SPREAD

## PROMOTED SPREAD



# Results: Suppression Actions



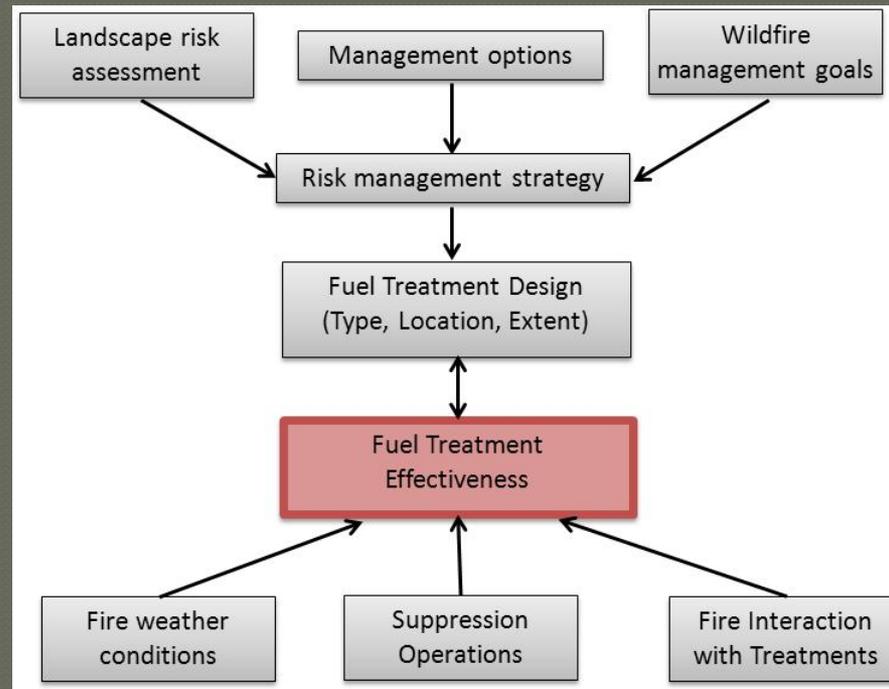
# Ongoing & Future Work

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- Expanding analysis of treatment effectiveness
  - HVRA response to fire and avoided losses
  - Temporal dynamics; windows of suppression opportunity
  - Suppression effectiveness and safety
  - Incident decision making

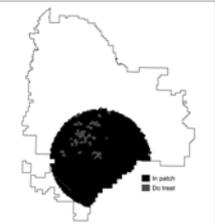
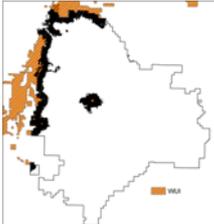
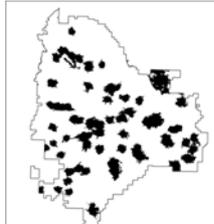
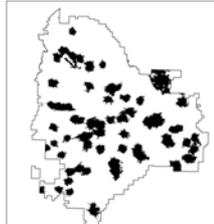
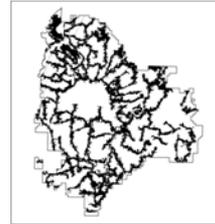
# Planned deliverables

- Treatment Design
- Treatment Evaluation
- Treatment Decision Process

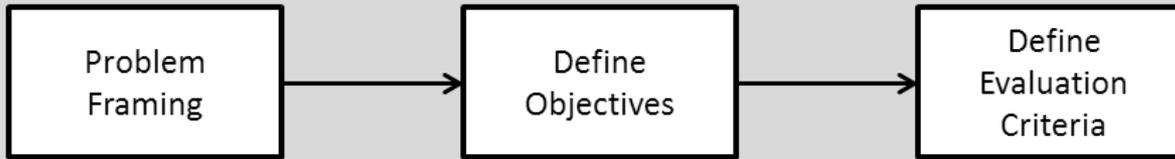


# Questions?

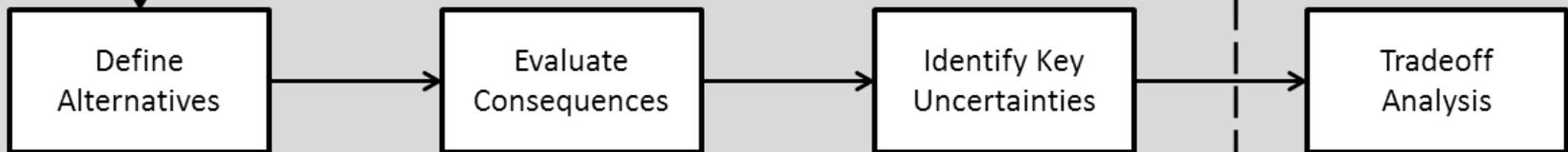
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<b>Motivation</b>	Restoration	Protection	Protection	Protection	Restoration	Protection
<b>Fire regime</b>	Low severity (+ fire)	Mixed severity (+/- fire)	Mixed severity (+/- fire)	High severity (- fire)	High severity (- fire)	High severity (- fire)
<b>Pattern of values</b>	Dispersed (large trees)	Dispersed and prevalent (low density WUI, T&E)	One clump	Clumpy	Any	Low or none
<b>Treatment Strategy</b>	Create large contiguous areas of low hazard (minimum treatment for maximum area)	Strategic (SPLATs/SPOTs)	Localized protection (targeted treatments)	Localized protection (targeted treatments)	Restore natural fire barriers	Defensible fuel breaks along roads and other barriers
<b>Treatment system</b>	Low hazard fire containers	Treatment optimization model (FlamMap; TOM)	Defensible fuel breaks	Defensible fuel breaks	Strategic restoration	High hazard fire containers
<b>Spatial treatment pattern</b>						

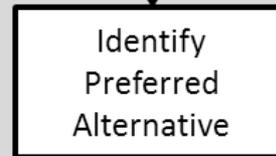
## Problem Structuring



## Problem Analysis



## Decision Point



## Implementation & Monitoring

