Cumulative Impacts Assessment for Timber Harvest

How Best to Incorporate Wildfire Risk and Hazard

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Background

California has 17 million acres of timberland designated for production of commercial wood products. Under the **Forest Practice Act of 1973**, the State's jurisdiction encompasses 7 million acres of private timberlands and ensures timber harvesting is completed in a sustainable manner. The California Board of Forestry and Fire Protection (**CAL FIRE**) is charged with upholding the Act.

Timber permits – known as **Timber Harvesting Plans (THPs)** – must be approved by CAL FIRE prior to the initiation of timber activities. These reports are completed by a **Registered Professional Forester** and describe the property, proposed harvest methods, and expected environmental impacts. The THP's Cumulative Impacts Assessment section considers potential adverse environmental effects of a project on specific resources.

As of January 2019, CAL FIRE added ***Wildfire Risk and Hazard*** as a new resource to be evaluated within the Cumulative Impacts Assessment section (CCR Title 14 § 912.9). This new section requires applicants to determine whether significant cumulative environmental impacts will occur on wildfire risk and hazard following tree removal. However, a standardized **methodology to evaluate this section has not been developed**.

Key Definitions

Wildfire Hazard: A measure of the likelihood of an area burning and how it burns

Wildfire Risk: A measure of potential for damage. Risk considers the susceptibility of what is being protected – communities and dwellings

Project Approach

Our primary **objective** was to create **a tool to standardize the evaluation** of the effects of proposed timber harvests on wildfire risk and wildfire hazard.

To approach this objective, we asked three primary **research questions**:

Knowledge: What does science say about how timber harvests may impact wildfire risk and wildfire hazard?

Challenges: What barriers and challenges exist for Registered Professional Foresters in the Timber Harvest Plan Process?

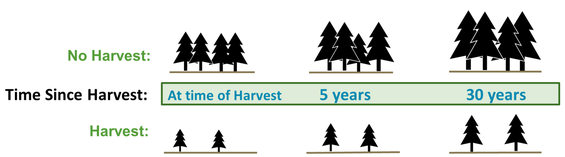
Evaluation: What credible and feasible tools exist to measure the impact of timber harvest on wildfire risk and hazard?

KNOWLEDGE: Incorporated into Results

The results of our literature review informed our development of several standardized tools. Two of our formative choices are below:

Wildfire Hazard + Susceptibility = Wildfire Risk

FIRST - Adopting CAL FIRE definitions, we defined this relationship between wildfire risk and wildfire hazard.



SECOND – The change in forest structure over time is central to the evaluation of wildfire hazard. We recommend evaluating wildfire risk and hazard at three time steps.

EVALUATION: Approach for Wildfire Risk and Hazard

1 Apply the Decision Tree

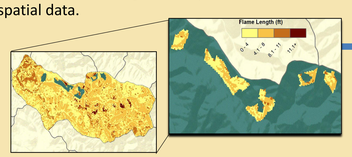
We developed this **decision tree** to step Registered Professional Foresters through our **series of recommended approaches**, based on data availability for a given timber plot. The decision tree steps through the **conceptual formula** describing the relationship between hazard and risk.

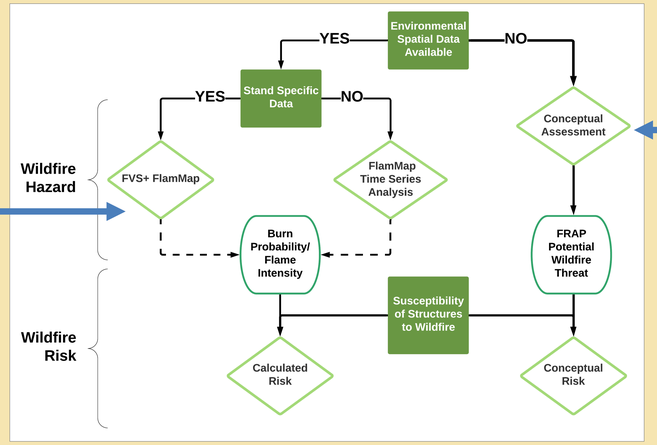
3 Apply a Model, if data available

The *gold standard* is the FVS+FlamMap coupling. This pair simulates tree growth and tracks changes in flame length over time, producing an estimate for wildfire hazard. The second option is inferring timber impacts using FlamMap and historical spatial data.

FlamMap Output:

Model outputs estimating flame length as a metric for wildfire hazard.





2 Conduct Conceptual Assessment

Rules Table: Summary of major drivers of wildfire hazard

Component	*Hypothesis*	*Literature Reviewed*	*Inferred Timber Harvest Implication*
Fuel Treatment Types	1a. Fuel treatments, including prescribed burning and thinning, reduce forest density, raise crown base height, and can lower crown bulk density	Fulé, P. Z., Waltz, A. E. M., Covington, W. W. & Heinlein, T. A.	Reducing density, raising crown base height, and reducing crown bulk density are linked with decreased wildfire hazard.
Species composition	2a. Fire resistant species in the mixed-conifer forests of Sierra Nevada include ponderosa pine, giant sequoia, and black oak.	Witherspoon *et al.*	Fire resistant species can offer some reduction in wildfire hazard if grown in harvested forests
Management (Suppression) Activities	3a. Most forests in California have undergone change resulting in altered fire regime.	Steel, Z. L., Koontz, M. J. & Safford, H. D.	Altered fire regimes introduce uncertainty about fire severity
Topography	4a. Wildfire hazard increases with increasing slope angle	Aspen, pinyon-juniper, mixed-conifer forest in CO - *Romme, W. H., Barry, P. J., Hanna, D. D., Floyd, M. L. & White, S., Omi & Martinson*	Wildfires are more severe on steeper slopes due to flame tilt, providing for more horizontal connectivity.

Peer-reviewed and grey literature were reviewed to understand the relationship between timber harvests and wildfire behavior. Due to lack of research specifically on timber harvest methods, we formed a **generalized rule table to inform evaluation** of potential impacts from timber harvest operations on fire behavior. An excerpt is shown above.

Application: Campbell Creek Watershed Case Study

Campbell Creek Planning Watershed is located in Humboldt County along the northern California coast in **one of the most productive timber regions**. It was selected as the case study due to being a **well-researched watershed** managed by the California Natural Resources Agency. This site is **representative of typical timbered areas**, as the watershed has been harvested many times over the last few decades. Our case study focuses on Timber Harvest Plan 1-07-036-MEN. Under this permit, the site was harvested in 2009, followed by regrowth.

Step 1: Estimate the Wildfire Hazard

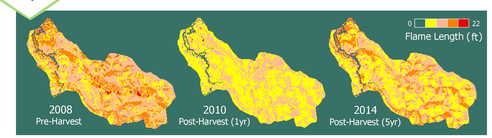
At each time step, apply the selected method to determine the change in Wildfire Hazard following a timber harvest.

Wildfire hazard can be assessed utilizing **conceptual and/or quantitative** methods.
The **quantitative method** is strongly recommended if spatial data are available. In our Case Study, stand-level data were not available, so the **time-series approach** was applied to understand trends in flame length – an indicator of potential fire behavior.

Conceptual Assessment — Evaluates each characteristic based on predicted forest regrowth and tree characteristics.

Category	Condition	Immediately Post-Harvest	5 Years	30 Years
Stand Structure	Canopy Bulk Density (crown fuels)			
	Canopy Cover			
	Horizontal Continuity (stand density)			
	Vertical Continuity (ladder fuels)			
Stand Composition	Community Composition			
	Large Tree Density			
Surface Fuels	Surface fuel loading			
	Surface fuel structure			

FlamMap Time Series Analysis — Historical satellite data are run through FlamMap at each time step following a harvest method similar to that proposed.

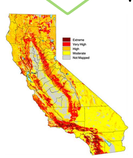


Step 2: Estimate the Wildfire Risk

Using Wildfire Hazard results from each time step, apply the selected method to calculate Wildfire Risk.

Wildfire risk can be assessed utilizing **conceptual and/or calculated** methods.
The **calculated method** is strongly recommended if spatial data are available. In our Case Study, FlamMap data and susceptibility data were applied to calculate the **percent Net Value Change** for each pre-harvest and post-harvest year.

Conceptual Risk — Uses CAL FIRE Potential Fire Threat map to evaluate existing fire susceptibility in the watershed.



RESULTS: CONCEPTUAL RISK

1. 68% of Forested range land in Campbell Creek is in Wildfire Condition Class Moderate to High
2. This threatens 42% of the structures located within the area.

Calculated Risk — Integrates burn probability, fire intensity, and susceptibility data to calculate changes to Wildfire Risk if a fire were to occur.

RESULTS: CALCULATED RISK

Percent Net Value Change if a fire occurs within a specific year.

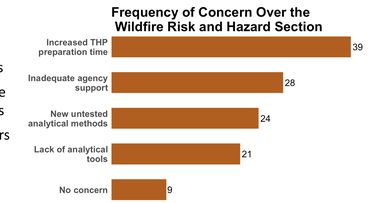
$Risk_{2001}$ = 32.2% (Pre-Harvest)
$Risk_{2008}$ = 31.5%
$Risk_{2010}$ = 29.4%

CHALLENGES: Forester Surveys

Surveys were sent to all Registered Professional Foresters in California (n = 76) in order to collect input on 1) **definitions** for wildfire risk and wildfire hazard, 2) perceived **barriers** to completing the new section, 3) current use of **technical tools**, and 4) the **effective design** of a guidance document.

Key Survey Results:

1) RPFs rely heavily on agency resources
2) At least 33% of respondents apply fire protection methods to harvest areas
3) Use of GIS is common among foresters



Recommendations

1. Encourage research to fill the gap pertaining to the effects of timber harvest operations on wildfire hazard
2. Further develop technical guidance documents available for the completion of the new THP section.
3. Develop guidance specific to regions underrepresented in forest management literature.

Key Contributions to a Guidance Document:

1. Scale of Assessment: California Planning Watershed
2. Timeline of Assessment: Pre-harvest & Post-harvest
3. Hazard Metric of Assessment: Crown fire conversion
4. Hazard Method of Assessment: Qualitative or Quantitative
5. Risk Metric of Assessment: Distance of THP from WUI
6. Mitigation Strategies: List of recommended options

Acknowledgements

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