Cumulative Impacts Assessment for Timber Harvest
How Best to Incorporate Wildfire Risk and Hazard

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Background: Timber Harvest Plans

To ensure sustainable forest management, private timberland owners in California must hire a Registered Professional Forester to submit a Timber Harvest Plan to the California Board of Forestry and Fire Protection (CAL FIRE), and receive approval before harvesting their trees. The Cumulative Impacts (CI) Assessment section of a Timber Harvest Plan documents potential adverse environmental effects of a timber harvest project. In January 2019, in response to growing concerns about wildfires, California added Wildfire Risk and Hazard as a new section in the CI portion of Timber Harvest Plans (CCR Title 14 § 912.9).

The Problem

This new Wildfire Risk and Hazard section lacks definitions for wildfire risk and wildfire hazard, and does not provide guidance on methods or metrics of assessment.

Our Approach

Our team identified viable options for implementing the new Wildfire Risk and Hazard section and explored many components including, but not limited to: proper interpretation of regulatory language, consideration of legal history over CI assessments, the application of best available science, and feasibility of assessment by Registered Professional Foresters.

Research Questions

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

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

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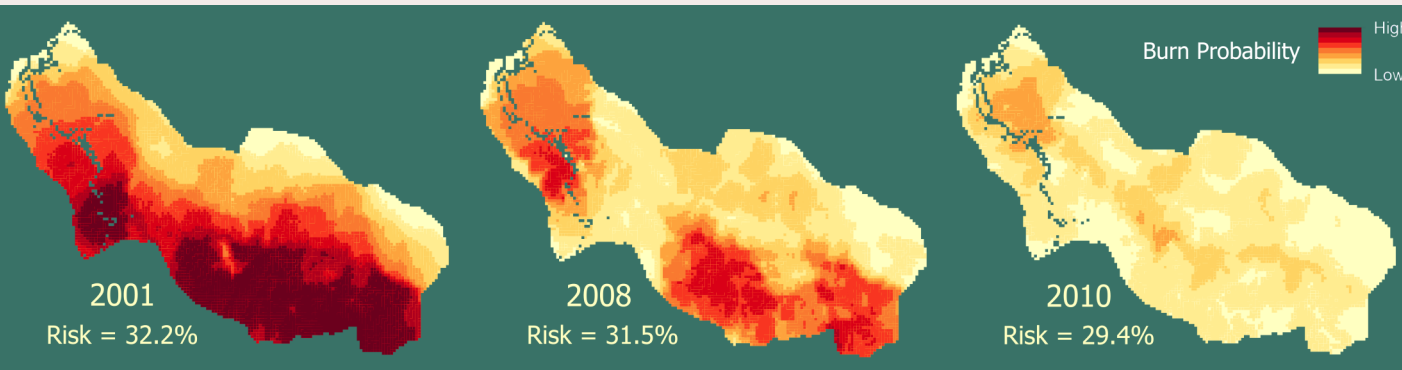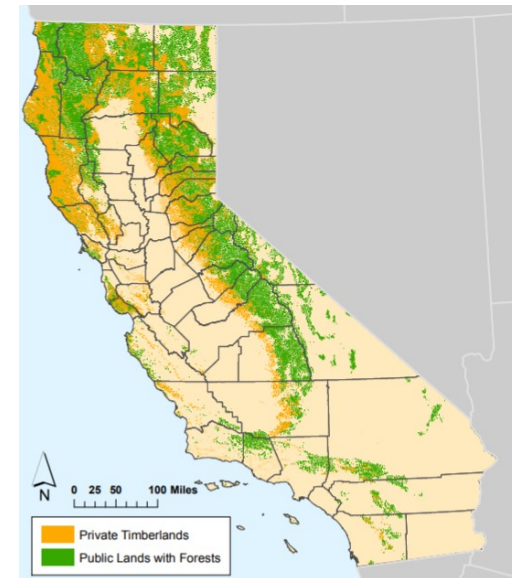

Wildfire Risk

Conceptual Assessment of Risk

Based on FRAP Potential Wildfire Threat information we determined that:
- 68% of Forested range land in Campbell Creek is in Wildfire Condition Class Moderate to High
- This threatens 42% of the structures located within the area

FRAP Potential Wildfire Threat

Quantitative Assessment of Risk

Using a time series burn probability analysis from FlamMap (below), Wildfire Risk was calculated as a change to Net Present Value if a fire were to occur.

Burn Probability — High / Low

2001 — Risk = 32.2%

2008 — Risk = 31.5%

2010 — Risk = 29.4%

Recommendations

Further Research

We recommend further research be completed to better understand how timber harvest operations alter forest structure and composition, leading to changes in wildfire behavior over time. Further, continued efforts should include potential climate change scenarios to more fully capture potential adverse cumulative impacts that result from timber harvest actions.

Agency Actions

As part of this project, a memo and Guidance Document will be prepared to direct Registered Professional Foresters on how to assess Wildfire Risk and Hazard resulting from proposed timber harvest actions.

Our *Memo* will include recommendations to CAL FIRE on research gaps that should be addressed in timber harvest and wildfire.

Our *Guidance Document* will provide guidance on the scale, timeline, and metrics of Wildfire Risk and Hazard assessment.

Key Findings: Knowledge

There are significant gaps in knowledge of how timber harvest actions impact wildfire. Wildfire Hazard and Wildfire Risk are defined inconsistently, or used without being defined, throughout peer-reviewed and grey literature. For this project, our team adopted definitions from CAL FIRE and determined the following relationship.

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

+ Proximity to people and infrastructure **=**

Wildfire Risk: A measure of potential for damage. Risk considers the susceptibility of what is being protected – communities and dwellings
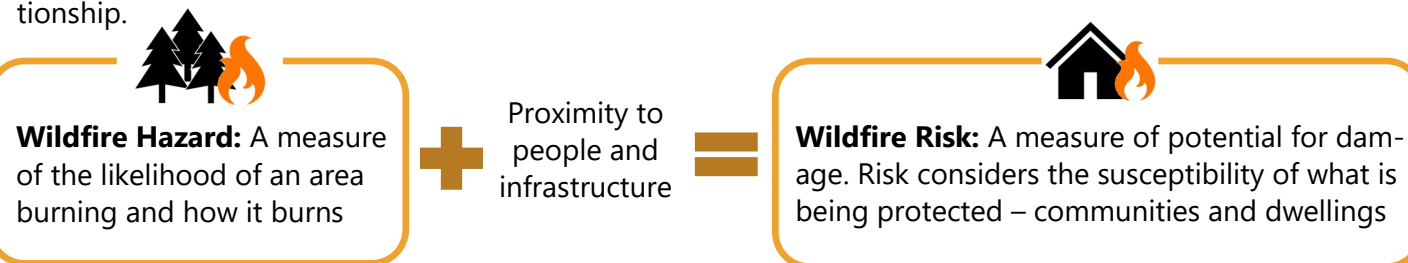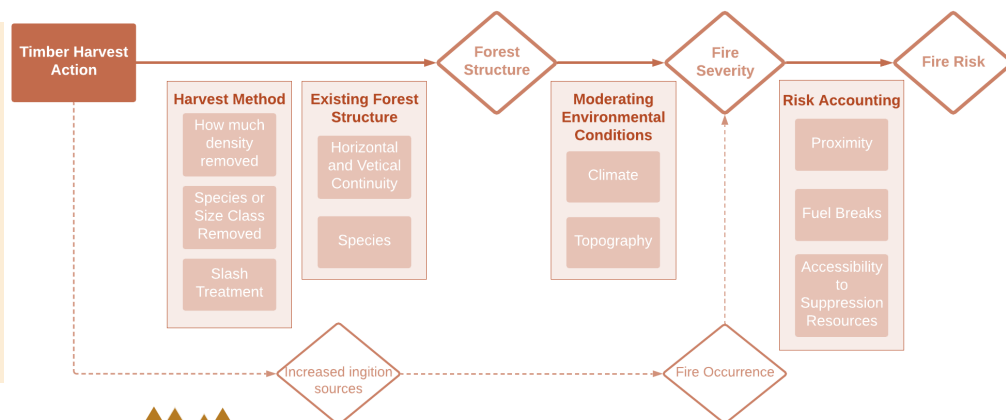
Our team reviewed peer and grey literature to understand the relationship between timber harvest and Wildfire Risk and Hazard. From this review, we developed a conceptual model (below) for how timber harvest actions affect forest structure, and how that change affects fire risk. We also determined that ignition sources and probability of fire occurrence would fall outside of the scope of our project. Based on our literature review and this conceptual model, we developed a series of assessments for Wildfire Risk and Hazard.

Research Gaps

Four main gaps were identified in the literature:

1) Forest type diversity
2) Land ownership
3) Longevity of study
4) Timber harvest studies

Conceptual model:

Timber Harvest Action → Forest Structure → Fire Severity → Fire Risk

Harvest Method: How much density removed; Species or Size Class Removed; Slash Treatment

Existing Forest Structure: Horizontal and Vertical Continuity; Species

Moderating Environmental Conditions: Climate; Topography

Risk Accounting: Proximity; Fuel Breaks; Accessibility to Suppression Resources

Increased ignition sources → Fire Occurrence

No Harvest / Time Since Harvest / Harvest:
At time of Harvest — 5 years — 30 years

Based on our literature review, we determined that Wildfire Risk and Hazard should be evaluated at three time steps, both pre- and post-harvest, to capture changes to forest structure over time.
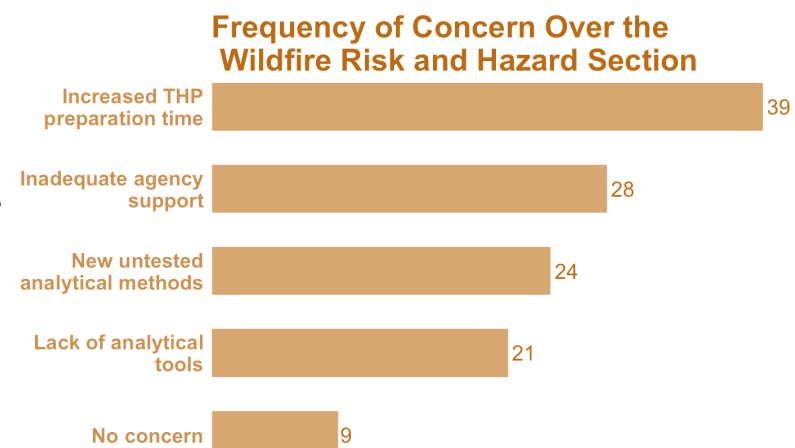
Key Findings: Challenges

Surveys were sent to all Registered Professional Foresters (RPF) in California, of which 76 responded. We aimed to learn about perceived barriers to completing the new Wildfire Risk and Hazard section, understand the current use of technical tools in Timber Harvest Plan preparation, and inform the design of an effective guide for completing the new section.
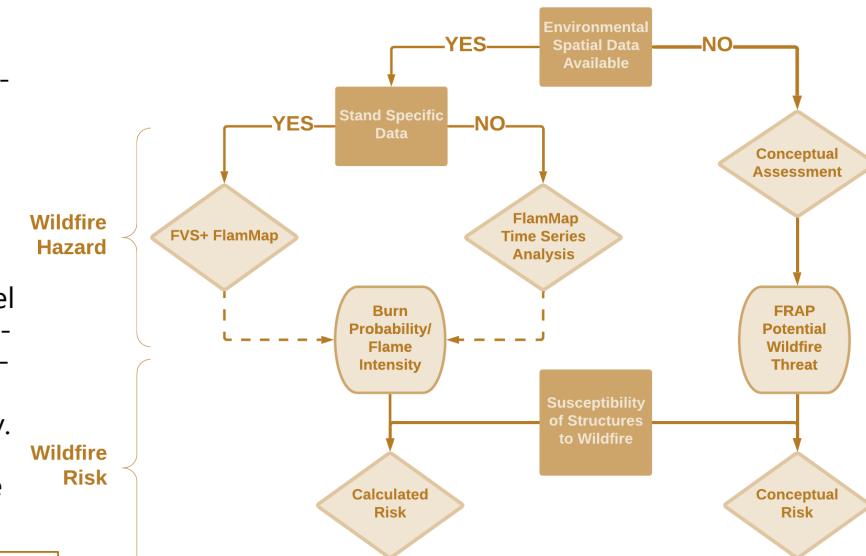
Key Survey Results

1) Registered Professional Foresters 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

Frequency of Concern Over the Wildfire Risk and Hazard Section

Concern	Count
Increased THP preparation time	39
Inadequate agency support	28
New untested analytical methods	24
Lack of analytical tools	21
No concern	9

Key Findings: Evaluation

Decision Tree for Assessment

In response to Registered Professional Foresters' concerns about a lack of analytical tools in the new Wildfire Risk and Hazard section, our team reviewed 15 scientific models that could be used to determine changes to wildfire hazard resulting from timber harvest actions. We selected the Forest Vegetation Simulator (FVS) to model forest growth and FlamMap to model wildfire hazard. Our team also developed alternative approaches for assessing Wildfire Risk and Hazard, based on data availability. Our decision tree (right) will help Registered Professional Foresters determine the best method of assessment for their site.

Decision Tree:

Wildfire Hazard — Stand Specific Data → YES: FVS+FlamMap / NO: Environmental Spatial Data Available → YES: FlamMap Time Series Analysis / NO: Conceptual Assessment → FRAP Potential Wildfire Threat → Burn Probability/Flame Intensity

Wildfire Risk — Susceptibility of Structures to Wildfire → Calculated Risk / Conceptual Risk

Section	Hypothesis	Citation	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.

Conceptual Assessment: Rules Table

We developed a generalized rule table (left) that summarizes the major drivers of wildfire hazard in timber harvest and forest management. These principles would inform Foresters' intuition in a case where no environmental spatial data exist for a site.

Flame Length (ft): 0 - 4, 4.1 - 8, 8.1 - 11, 11.1+

Quantitative Assessment: FVS + FlamMap

If stand specific environmental spatial data are available for a site, changes to Wildfire Hazard (using flame length as a metric) should be modeled using FVS and FlamMap, producing outputs similar to those shown (right).
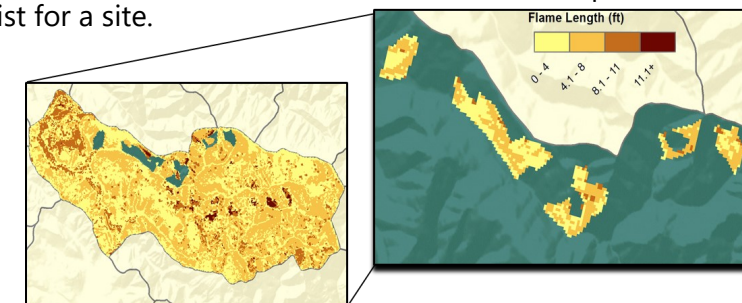
Application: Campbell Creek Watershed Case Study

Campbell Creek Planning Watershed is located in Humboldt County along the northern California Coast in one of the most productive timber regions. It is a well-researched watershed, currently managed by the California Natural Resource Agency. Under this permit, the site was harvested in 2009, followed by regrowth. Since stand level data were not available for this site, we performed an analysis using historical satellite data from a previous timber harvest (THP 1-07-036-MEN).

Wildfire Hazard

Flame Length (ft): 0 — 22

2008 Pre-Harvest

2010 Post-Harvest (1yr)

2014 Post-Harvest (5yr)