Initial Concept Proposal

a. Date Submitted: 5/19/2025

b. Project Title: Evaluating Post-Fire Restocking Strategies and Their Effectiveness in Promoting Wildfire Resilience in Industrial and Non-Industrial Timberlands

c. Project #: To be assigned by EMC

d. Principal Investigator(s) (PI): David Saah, Jason Moghaddas

e. Affiliation(s) of PI(s) and Address(es): Spatial Informatics Group

f. Applying Organization: Spatial Informatics Group

g. Primary Contact Phone Number(s): [redacted]

h. Primary Email Contact(s) of PI(s): [redacted]

i. Name(s) and Affiliation(s) of Collaborator(s): Pre-proposal concepts have been shared with Cal Fire and RPFs with expertise in the area and subject matter. More detailed partnerships will be developed if preproposal is accepted

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j. Project Description

i) Project Duration: 18 months

ii) Background and Justification:

California's Northern Forest District has experienced numerous fires in the last three decades ranging in size from small (<5K acres) to extremely large (>900K acres). The largest of these fires was the 2021 Dixie Fire, which was not only unprecedented in scale and severity but also reburned several recently burned areas, including the 2007 Moonlight Fire, 2019 Walker Fire, 2000 Storrie Fire, 2020 North Complex Fire, and several others.

The Northern Forest District is one of California's most productive timberlands, with a mix of private industrial, private non-industrial, and public forests. The post-fire management of these lands—including salvage logging, logging residue management, replanting strategies, and stocking densities—varies significantly by ownership type, creating a unique opportunity to assess the long-term effectiveness of different post-fire restocking and rehabilitation strategies as they relate to forest regeneration, sustainable timber harvest, and timber quality.

California's Forest Practice Rules (FPRs) establish restocking standards for post-fire recovery, aiming to balance timberland productivity, wildfire resilience, and ecological restoration. However, the effectiveness of these regulations in mitigating fire risk and sustaining forest productivity remains uncertain, particularly in the context of large-scale industrial and non-industrial timberland management in an age of extreme weather and fire.

A key consideration is the role of post fire tree removal ("salvage harvest"), which can be implemented after high-severity wildfires to recover some economic value, and prepare industrial timber sites for replanting. While salvage harvests can reduce fire risk and disrupt the establishment of shrub/herbaceous vegetation, research suggests (McGinnis et al., 2010, Leverkus et al., 2021) that intensive post-fire management—including high-density replanting—may create homogenous stands with higher fuel loads, potentially increasing fire severity in subsequent burns. Conversely, areas left to regenerate naturally may exhibit greater structural diversity but may not meet productivity or fire resilience goals.

By analyzing post-fire regrowth, stand structure, and subsequent burn severity within previously burned and restocked areas, this study will assess whether existing FPR salvage and stocking standards promote wildfire resilience while maintaining long-term timberland productivity.

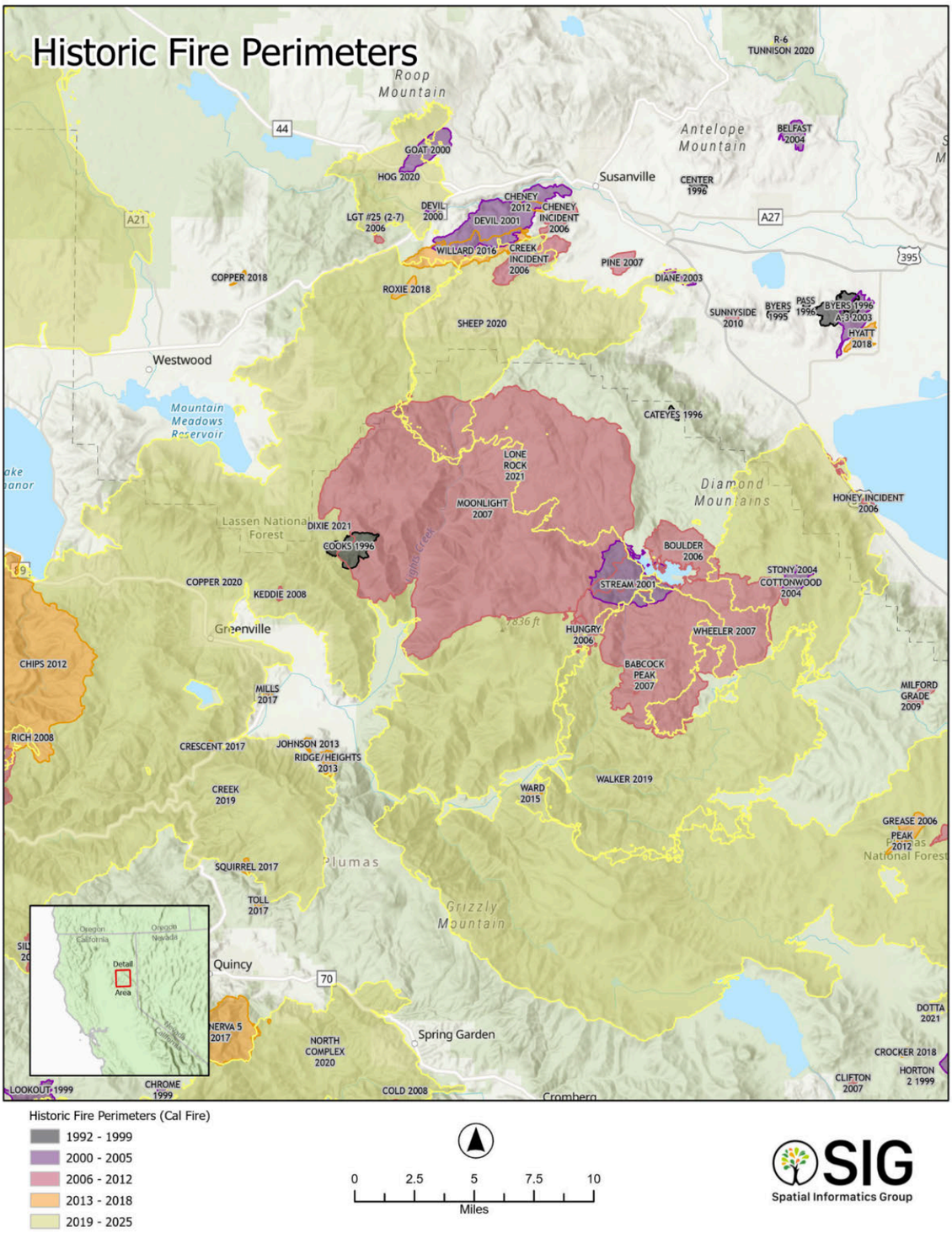

Figure: The above map details the recent fire history in a segment of California's Northern Forest District with a concentration of timber land. This area has been selected as an example of the opportunity to study restocking standards as they relate to post-fire outcomes in timber harvest areas that have seen repeated fire.

iii) Objectives and Scope:

- Evaluate how different post-fire restocking strategies (e.g., site preparation, planting density, species composition) influenced forest structure before and after subsequent wildfire events.
- Assess how plantation areas were used to help contain or slow wildfires and where they burned with high severity or contributed to fire spread
- Compare industrial and non-industrial post-fire timberland restocking outcomes in terms of wildfire resilience and sustained yield.
- Assess whether current FPR stocking standards adequately promote fire-adapted forest structures.

- Identify potential regulatory or silvicultural modifications that could improve post-fire recovery and resilience.

iv) Research Methods:

- **Study Area Selection:** Northern Forest District, focusing on sites that have burned twice (e.g., the overlap of the Moonlight and Dixie fires) analyzing areas with different restocking approaches (e.g., industrial plantations, non-industrial natural regeneration, mixed silvicultural treatments).

- **Data Collection:** Utilize remote sensing (e.g., Landsat. Sentinel-2, and Dynamic World), spatial data from timber harvest plans (TA83 shapefiles), historical stand treatment records (FACTS) to assess stand structure, species composition, and fuel accumulation. Building on Pelletier et al. (2024), we will apply intra- and inter-annual change detection using harmonized Landsat and Sentinel-2 imagery to quantify stand-replacing disturbances and track aboveground biomass (AGB) loss and gain. This approach enables near-real-time monitoring of post-fire recovery dynamics and provides spatially explicit insights into the effectiveness of silvicultural practices. Additionally, field surveys using visual, and 360º and UAV imagery will be conducted to ground truth conclusions derived from remote data analysis.

- **Burn Severity Analysis:** Compare burn severity in restocked areas using Monitoring Trends in Burn Severity (MTBS) data and other fire behavior modeling tools.

- **Statistical Analysis:** Use multivariate regression analysis to assess correlations between post-fire stand restocking methods (e.g., stocking density, species mix, fuel loads) with reburn outcomes (e.g. Moonlight/Dixie fire overlap).

- **Modeling and Forecasting:** The Forest Carbon Accounting Tool (FCAT), developed by SIG, is a streamlined workflow for simulating forest growth dynamics and management actions in the Forest Vegetation Simulator (FVS) and using FVS outputs in a Monte Carlo wildfire spread simulation. FCAT facilitates landscape-scale analyses of how management actions (including no action, salvage logging, planting, and various fuel treatments) impact future wildfire hazard potential and forest carbon stocks through time. The proposed project will use FCAT to model pre- and post-reburn (i.e., second fire) restocking/vegetation trajectories in burned areas. Post fire outcomes will be modeled under several different restocking and intermediate treatment scenarios and compared to known outcomes.

    - FCAT model inputs include, but are not limited to, post-fire (salvage) harvesting methods, residual harvest material management, restocking parameters, and intermediate treatments.

- **Fire Hazard:** The proposed project will use First Street Foundation (FSF)–Fire Factor to assess current fire hazard using FSF's proprietary data for mean conditional flame length and annual burn probability. The Forest Vegetation Simulator (FVS) will be used to model fire hazard under different silviculture scenarios.

- **Comparative Policy Review:** Examine how different landownership types adhered to FPR restocking regulations and assess their effectiveness in promoting resilient forests

    - Use Monitoring Trends in Burn Severity (MTBS) to assess post-fire outcomes as they relate to restocking methods (e.g. site preparation, planting densities).

    - Assess current fire hazard as it relates to restocking methods using FSF Fire Factor data,

    - Forecast future forest vegetation composition and fire outcomes at discrete intervals for the next 30+ years using FCAT.

        - Model alternate outcomes based on changes in restocking requirements

v) Scientific Uncertainty and Geographic Application:

The proposed study addresses key uncertainties in post-fire restocking effectiveness, particularly regarding stocking density, species selection, and long-term wildfire resilience. The findings will have direct applicability to forested regions across California, particularly the Northern Sierra Nevada and Southern Cascade Mountains where fire-prone landscapes and diverse ownership patterns may benefit from adaptive management strategies.

Geographic Focus: Northern Forest District focusing in and around Plumas County with applicability to other fire-affected regions in California particularly in the Southern Cascade and Sierra Nevada Mountains.

vi) Collaborations and Project Feasibility:

- **Possible collaborators and sites can include:**
  - Local Forest Land Management and Reforestation RPFs
  - Local Agencies (CAL FIRE, RCD)
  - Jessi Brown (Sparrowhawk Data Science)
  - Established cluster and traditional planting in the Antelope Lake (2006 Boulder Fire) and 2007 Moonlight Fire Area, and other private lands in the region.
- **Feasibility:** This project is highly feasible due to the research team's deep expertise, established partnerships, and proven track record in forest and fire management research. Spatial Informatics Group has successfully led similar large-scale interdisciplinary projects (EMC-2019-002 and EMC-2023-002, NASA funded Post Wildfire Vegetation Recovery and Mapping Tool), and our team already collaborates with key landowners, agencies, and academic partners in the region. The study area is well understood and accessible, and our team has the tools and experience needed to efficiently integrate remote sensing, field data, analysis, and modeling. With a clear focus, strong institutional support, and direct alignment with regulatory priorities, the project is well-positioned for successful completion within the proposed 18-month timeline.

vii) Alignment with EMC Monitoring Gaps:

This study addresses a gap in the EMC's existing project portfolio, as identified in the 2024 Crosswalk. While past efforts have examined fire severity and fuel treatments, no funded projects have directly evaluated the effectiveness of current post-fire stocking standards (14 CCR § 932.7) or slash treatment rules (14 CCR § 937.2) in promoting wildfire resilience. This proposal uniquely links restocking policy, fuel hazard, and forest productivity, expanding EMC's understanding of how FPRs influence fire outcomes across ownership types and management strategies.

k. Critical Question Theme and Forest Practice Rules or Regulations Addressed.

This project will address Theme 6 Wildfire Hazard, critical questions:

(d) Managing forest structure and stocking standards to promote wildfire resilience?

Stocking Standards (14 CCR § 932.7):

The project will assess whether post-fire restocking practices meeting the minimum standards outlined in 14 CCR § 932.7 result in forest structures that enhance wildfire resilience. By analyzing stand conditions and burn severity across ownership/management types, it will evaluate if current stocking levels effectively reduce fuel continuity and promote fire-adapted landscapes.

Alternative Stocking Standards (14 CCR § 932.7(b)(1)(D)):

The project will examine whether the use of alternative stocking standards under 14 CCR § 932.7(b)(1)(D) leads to more resilient post-fire forest conditions. By comparing outcomes from areas using standard versus alternative approaches, the study will evaluate how flexibility in stocking requirements influences long-term fire behavior and forest health.

(g) Maintaining timberland productivity, including wood quality and sustained yield after wildfire?

Maximum Sustained Production (MSP) (14 CCR § 933.11):

The project will evaluate whether post-fire restocking strategies align with the intent of 14 CCR § 933.11 by supporting long-term timberland productivity and wood quality. By comparing regeneration outcomes and stand development across ownerships and treatments, it will assess if current practices meet MSP goals following wildfire.

(a) Treating post-harvest slash and slash piles to modify fire behavior?

Slash Treatment Requirements (14 CCR §§ 937.2, 1038):

The project will evaluate how slash treatment practices required under 14 CCR § 937.2, which governs slash disposal in the Northern Forest District, influence fuel continuity and fire behavior. This section outlines specific requirements for lopping, scattering, chipping, or burning slash to reduce fire hazard within defined distances of roads and firebreaks. In addition, the study will assess how slash treatments implemented under post-fire timber harvest exemptions (e.g., 14 CCR § 1038) comply with these requirements and whether they promote conditions conducive to wildfire resilience. By examining how slash and landing debris are handled under these provisions, the project will analyze their role in modifying fire behavior in restocked areas.

Operational Requirements (14 CCR § 1052.4):

The project will also consider slash treatment practices conducted under 14 CCR § 1052.4, which outlines operational requirements for emergency timber operations, including post-fire salvage. It will assess whether these emergency-related requirements are effectively reducing fuel hazards and supporting long-term fire-adapted forest conditions when used in conjunction with restocking strategies.

I. Requested Funding

Category	Description	Year 1 (01/01/-12/31/2026)	Year 2 (01/01/-06/30/2026)	Total
Personal Salaries and Wages	Staff Salary	$37,000	$18,500	$55,500
Fringe Benefits (25%)	Staff Fringe Benefits-25% rate	$9,250	$4,625	$13,875
Contractual Expenses	Sparrowhawk Data Science (Dr. Jessi Brown)	$6,250	$6,250	$12,500
Operating Expenses	None	$0	$0	$0
Travel (Please see Match row; this is NOT counted twice)	$500/year-contributed below	$500	$500	$1,000
Other	None	$0	$0	$0
Indirect Costs	Indirect Rate 15%	$2,625	$4,500	$7,125
EMC FUNDING*	Year 1 and 2 requested funding	$55,625	$34,375	$90,000
Match or In-Kind Contributions	Contributed Labor ($1,000 per year) and Travel ($500/year)	$1,500	$1,500	$3,000
Total Budgets	-	$57,125	$35,875	$93,000

***REQUIRED**