

PROPOSAL SUBMITTED FOR EFFECTIVENESS MONITORING PROGRAM GRANT FISCAL YEAR 2023–2024 RFP

Proposal Submitted May 24, 2023

Submitted to
State of California Natural Resources Agency
Effectiveness Monitoring Committee
State Board of Forestry and Protection

Submitted by
Spatial Informatics Group

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Affiliations and Collaborators:

Collaborators may include the Feather River RCD (Michael Hall), UC Cooperative Extension (Ryan Tompkins), Cal Fire (Jonathan Pangburn), USDA Forest Service (Plumas National Forest), W.M. Beatty and Associates. Letters of support will be requested from all if selected for a full proposal.

I Project Description

Research Themes to Be Addressed (note individual critical questions addressed in section VI)

Theme 1 - Watercourse and Lake Protection Zone Riparian Function

Theme 6 - Wildfire Hazard

Theme 12 - Resilience to Disturbance in a Changing Climate

Project Duration (Years/Months)

1 year and 6 months (January 2024-June 2025)

Background and Justification

Lakes, rivers, streams, and surrounding riparian vegetation on forest lands are critical for maintaining biodiversity while providing aquatic habitat, clean water, and flood control. They are also prized as recreation destinations. California's network of streams and lakes are home to a diverse range of plant and animal species, many unique to the state. They are also critical water sources for California's cities, farms, and energy sector. Stream and lake habitats can mitigate flooding by absorbing and slowing down floodwaters and protecting downstream communities. Lakes and streams provide many recreation opportunities, including fishing, boating, swimming, and sightseeing. The communities surrounding these bodies of water benefit economically from their proximity based on the tourism they attract. Several regions of California have had extensive portions of these lake and stream networks burned at high severity in several recent wildfires.

Over the past 20 years (1993-2023), hundreds of thousands of acres forested lands on both public and private lands have been directly impacted by wildfire, including recent large wildfires such as the Dixie Fire, North Complex, and Camp Fire, as well as older fires, including the Moonlight and Storrie Fires. Within these previous fires, a range of active management activities including tree removal and reforestation have occurred. In addition, large areas have been left “untreated” post wildfire.

The intersections of public and private lands within these fire footprints provide a unique opportunity to assess past, current, and future conditions of WLPZ areas under various management regimes ranging from inaction to high-cost mitigation programs.

Under the Forest Practice Rules, management of these stream zones are governed by 14 CCR

916.4, 936.4, 956.4 Watercourse and Lake Protection [All Districts] and 14 CCR 916.2, 936.2, 956.2 Protection of the Beneficial Uses of Water and Riparian Functions [All Districts], which generally limit use of mechanical harvesting equipment within fixed stream zone buffers (Figures 1-3) and specify tree retention requirements within Watercourse and Lake Protection Zones (“WLPZ”).

Procedures for Determining Watercourse and Lake Protection Zone Widths and Protective Measures ¹								
Water Class Characteristics or Key Indicator Beneficial Use	1) Domestic supplies, including springs, on site and/or within 100 feet downstream of the operations area and/or		1) Fish always or seasonally present offsite within 1000 feet downstream and/or		No aquatic life present, Watercourse showing evidence of being capable of sediment transport to Class I and II waters under normal high water flow conditions after completion of Timber Operations.		Man-made Watercourses, usually downstream, established domestic, agricultural, hydroelectric supply or other beneficial use.	
	2) Fish always or seasonally present onsite, includes habitat to sustain fish migration and spawning.		2) Aquatic habitat for nonfish aquatic species.					
			3) Excludes Class III waters that are tributary to Class I waters.					
Water Class	Class I		Class II		Class III		Class IV	
Slope Class (%)	Width Feet	Protection Measure	Width Feet	Protection Measure	Width Feet	Protection Measure	Width Feet	Protection Measure
					[see 916.4(c)] [see 936.4(c)] [see 956.4(c)]		[see 916.4(c)] [see 936.4(c)] [see 956.4(c)]	
<30	75	BDG	50	BEI	See CFH		See CFI	
30-50	100	BDG	75	BEI	See CFH		See CFI	
>50	150 ²	ADG	100 ³	BEI	See CFH		See CFI	
¹ - See Section 916.5(e) for letter designations application to this table. ² - Subtract 50 feet width for cable Yarding operations. ³ - Subtract 25 feet width for cable Yarding operations.								

Figure 1 – Procedures for determining water zone and lake protection zone widths and protective measures

Pursuant to 14 CCR 916.9[936.9,956.9](f)(2)						
Zone Designation	Zone width (ft.)	Overstory Canopy Cover		Large Tree Retention	Silviculture Requirements	Operational Requirements
Channel Zone	Variable	Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e) (1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v)	No Timber Operations except per 916.9 [936.9, 956.9] (e) (1)A-F or 916.9 [936.9, 956.9](v);
Core Zone per 916.9 [936.9 956.9] (f)(2)(A)	30 ft.	Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u).	No Timber Operations except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v);
Inner Zone per 916.9 [936.9 956.9] (f)(2)(B)	70 ft.	80% Coast and Southern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(2)(B)3.	70% in Northern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(2)(B)3.	13 largest trees /ac. per 916.9 [936.9 956.9] (f)(2)(B)4.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(2)(D)
Outer Zone per 916.9 [936.9 956.9] (f)(2)(C) Outer Zone applicable only where even-aged regeneration used adjacent to the WLPZ	50 ft.	50% per 916.9 [936.9 956.9] (f)(2)(C).1.		NA	Commercial thinning or single tree selection only; Retain wind firm trees.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(2)(D)
Special Operating Zone per 916.9 [936.9 956.9] (f)(2)(E)	50 ft.	NA		NA	SOZ applicable only where even-aged regeneration used adjacent to the WLPZ. Retain understory and midstory trees per 916.9 [936.9, 956.9] (f)(2)(E)	All other Forest Practice Rules

Figure 2 – Procedures for determining WLPZ widths and protective measures – Class I WLPZs – confined channels- Coastal anadromy zone

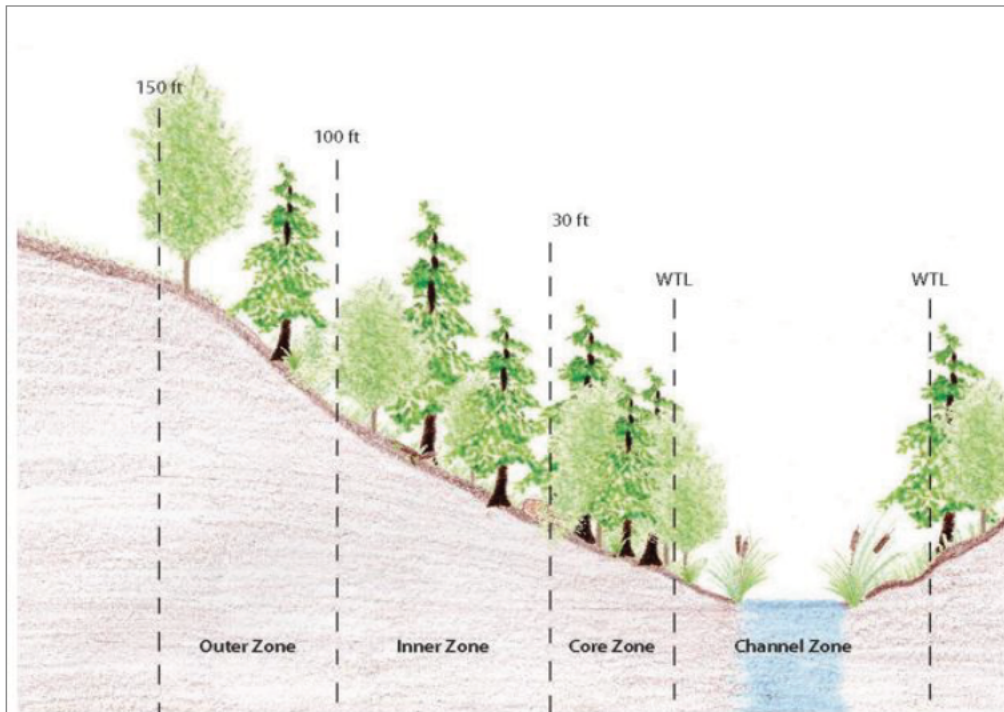


Figure 3 - Graphic profile of view of Class I WLPZ with confined channels in watersheds in the coastal anadromy zone (not to scale)

II Objectives and Scope

The objectives of this project are to assess past wildfire activity and severity, quantify current fire hazard and risk, and document current condition for WLPZ areas. The current condition assessment will focus on WLPZ will be conducted in Plumas County, a region of the state with a long history of wildfires affecting aquatic ecosystems on both private and public lands. The scope is focused on 5 analysis tasks, described below.

Task 1: Evaluate current fire hazard and risk for all lake, river, and stream (WLPZ) areas across regions of California contained within the Northern, Southern, Coast, and High Use Forest Districts.

Task 2: Quantify the acres burned per year by county and severity type (low, moderate, high) for all forested lands of California (excluding central valley) from 1984-2022 (MTBS and RAVG) as well as total acreage of stream zones burned per year from 1970-2022

Task 3: Use case studies in Plumas County to determine current conditions of WLPZs that cross public and private lands, focusing on WLPZ that have had various management actions (tree removal, reforestation) with unmanaged adjacent areas.

Task 4: Evaluate trends in vegetation cover (shrub, forest, grass, and bare and barren soil) for all riparian areas within Plumas County, using the existing Post WildFire Monitoring System funded by NASA (<https://sig-gis.com/post-fire-vegetation-monitoring-system/>).

Task 5: Summarize current fire hazard, fire history (severity), and case study findings to assess post fire riparian conditions.

Research Methods

Step 1-Locate WLPZ Areas using The National Hydrography Dataset (NHD): NHDPlus is a suite of geospatial products that build upon and extend the capabilities of the [National Hydrography Dataset \(NHD\)](#). The NHD is the most up-to-date and comprehensive hydrography dataset for the Nation. To assess potential WLPZ for current fire hazard, risk, and ecological condition, all watercourses will be buffered to a distance of 300 feet on each side of NHD mapped watercourses (600 feet total) and assessed. The NHD represents the water drainage network of the United States with features such as a comprehensive set of digital spatial data that encodes information about naturally occurring and constructed bodies of surface water (lakes, ponds, and reservoirs), paths through which water flows (canals, ditches, streams, and rivers), and related entities such as point features (springs, wells, stream gages, and dams). The information encoded about these features includes classification and other characteristics, delineation, geographic name, position and related measures, and the direction of water flow. (NDH Dataset <https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fhydro.nationalmap.gov%2Farcgis%2Frest%2Fservices%2Fnhd%2FMapServer&source=sd>)

Step 2-Determine Fire History and Severity of All Areas Delineated in Step 1: For all buffered areas created in step 1, the area burned by year will be estimated using GIS from 1970 to the present. In addition, all buffered stream areas will be assessed for total acres burned per year by burn severity (low, moderate, high) since 1984, the earliest available year for fire severity data. This information will be used to examine and analyze trends in fire extent and severity across all riparian areas. Rapid Assessment of Vegetation Condition after Wildfire (RAVG) and Monitoring Trends in Burn Severity (MTBS) provide 30-meter resolution, fire severity (vegetation) data. RAVG data is available 30-45 days after containment and is used by Silviculturists to determine reforestation needs. RAVG has categories like % Change in Basal area layer and % Change in Canopy cover layer while MTBS uses the 6-class thematic thresholded dNBR, unburned, low, moderate, high, increased veg, unvegetated, MTBS 1984-2021, and RAVG 2007-present. Both are 30-meter resolution (Fire Severity Data <https://gis.data.ca.gov/datasets/CALFIRE-Forestry::california-fire-perimeters-all-1/about> or <https://databasin.org/datasets/bf8db57ee6e0420c8ecce3c6395aceeb/>)

Step 3-Determine Current Fire Hazard: Using contemporary fire hazard and risk data,existing

hazard (flame length) and risk data (probability of burning) available at no cost to SIG from both the Pyregence (<https://pyregence.org/>) and First Street Fire Factor Project (<https://firststreet.org/risk-factor/fire-factor/>) for California will be summarized for all buffered stream areas within all Forest Districts of California.

Step 4-Plumas County Case Study, Determine Vegetation Change Over Time Using the Post Wildfire Vegetation Monitoring System for All Buffered Areas of Plumas County: Partnering with NASA, SIG has developed a Post Wildfire Vegetation Monitoring System. This system uses Landsat imagery within the Google Earth Engine Framework to provide near real time maps of forest, shrub, grassland, hardwood, and “barren” cover types (Figure 4). These are predicted with an accuracy of at least 80% and can be used to retrospectively create vegetation maps back to 1984. Within Plumas County, this system will be used to estimate the percent cover of forest, shrub, grassland, and barren types over all stream areas over time, including assessing changes in conditions within the Storrie Fire, Moonlight Fire, Dixie Fire, North Complex, Camp Fire, and others. Changes in vegetation can be detected across property lines (Figure 5)(Post (Wildfire Vegetation Monitoring System <https://sig-gis.com/post-fire-vegetation-monitoring-system/>)

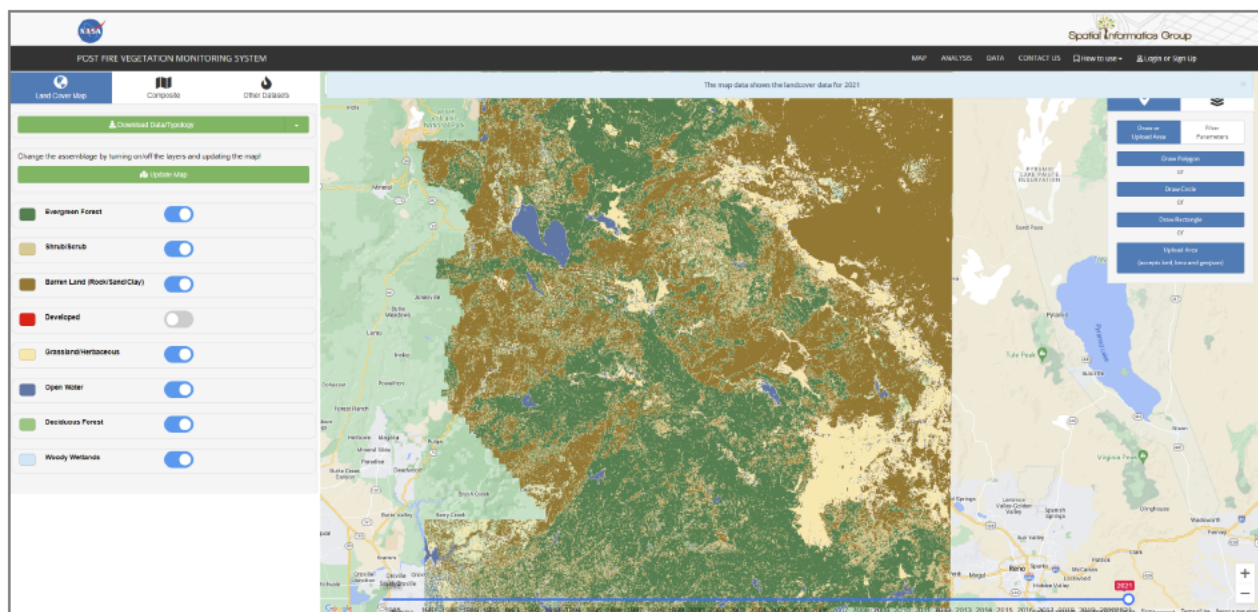


Figure 4 - Screenshot from the Post Fire Vegetation Monitoring System showing current cover of forest, shrub, barren, grassland, and other types of vegetation for all of Plumas County. The map reflects conditions of the 2021 Dixie Fire, including areas of the 2007 Moonlight Fire, which was reburned in the Dixie Fire.



Figure 5 - USFS (right) private land (left) boundary. The change from forest to shrub can be detected by the existing Post Wildfire Vegetation Monitoring System.

Step 5-Plumas County Field Case Study of Stream Condition: Within the Dixie and Moonlight Fires, 3 perennial and 3 ephemeral streams will be selected for detailed field study examining current condition of riparian areas in burned areas along private and public land boundaries. Within these case studies, percent cover of vegetation, current reforestation, and evidence of erosion will be documented (Figure 6). In addition, case study sites will be flown using a UAV to generate current condition high resolution imagery for use in the assessment to validate cover estimates. SIG has used UAVs in this area on past projects to map vegetation at high resolution- an example of imagery collected is available here (UAV Image Data Example <https://gsal.sig-gis.com/portal/apps/webappviewer/index.html?id=7cddcb5ee30d4c3e86f1463156eec8dc>)



Figure 6 - East Branch of Lights Creek within the footprint of the 2021 Dixie Fire. This area also burned in the 2007 Moonlight Fire.

Step 6-Report: Data and spatial information will be summarized into report form with online maps. All geospatial data will be provided electronically in ESRI compatible format.

IV Scientific Uncertainty and Geographic Application

The project findings will apply generally to vegetation common to forest communities across the Northern, Southern, Coastal, and High Use Forest Districts of California. Detailed case studies for Plumas County will apply broadly to similar vegetation types in the Northern Sierra Nevada. These include Sierran Mixed Conifer, East Side Pine, black oak woodland, sagebrush, and montane chaparral. A detailed analysis of treatments in these types at the county (Plumas) level will have broad application to similar vegetation types within the greater Northern and Southern Forest Districts. Monitoring findings will be generally applicable to similar vegetation types, soil types, and climate zones, within both the Northern and Southern Forest Districts. Coastal Region FPRs are included, however, comparisons will be more limited due to different vegetation types, local climate, and treatment practices.

V Collaborations and Project Feasibility

The project will include collaboration with the Feather River RCD, who is completing management work within the Moonlight Fire Footprint, CalFire (Jonathan Pangburn, RPF), Collins Pine, Sierra Pacific Industries, Beatty and Associates, UC Cooperative Extension (Ryan Tompkins, RPF), and the Plumas National Forest.

VI Theme and Critical Questions for Each Theme and Forest Practice Rules or Regulations Addressed

The project will cover fire history, severity, and current fire risk for all WLPZ areas as defined in the forest practice rules below.

- 916.4, 936.4, 956.4 Watercourse and Lake Protection [All Districts]
- 916.5, 936.5, 956.5 Procedure for Determining Watercourse and Lake Protection Zone (WLPZ) Widths and Protective Measures [All Districts]
- 916.2, 936.2, 956.2 Protection of the Beneficial Uses of Water and Riparian Functions [All Districts]

In addition, within Plumas County, the assessment will quantify the acres of WLPZ areas by cover type (forest, shrub, grassland, barren) since 1984, on both public and private lands. Specifically, the project will address aspects the critical questions for Theme 1, 6, and 12 per below.

Theme 1-Watercourse and Lake Protection Zone Riparian Function

The study will determine WLPZ areas that have lost or gained forest cover since 1984 for all of Plumas County. Understanding landscape and local change (gain or loss) of forest cover across all WLPZ areas will improve understanding of WLPZ function. Specifically, we will be able to determine how many acres of WLPZ was classified as forest as far back as 1984, how many acres of classified as forest in 2023, and the potential direct results of that loss or gain due to wildfire and reforestation efforts. Field assessments will provide fine grained assessments of cover and structure using both field and UAV data of select WLPZ areas that cross both private and public lands.

- A. Maintaining and restoring canopy closure to provide sufficient shade on watercourses necessary to meet Basin Plan temperature objectives?
- B. Maintaining and restoring stream water temperature?
- C. Retaining predominant conifers in WLPZs and large woody debris input to watercourse channels?

- D. Retaining conifer and deciduous species to maintain or restore riparian shade, water temperature, and primary productivity?
- E. Maintaining and restoring riparian function of Class II-L watercourses in the Northern District?
- H. Managing WLPZs to reduce or minimize potential fire behavior and rate of spread?

Theme 6 - Wildfire Hazard

The project will address Theme 6 (wildfire hazard), questions D, E, and F by providing historical analysis of acres burned by severity class (low, moderate, high) for all WLPZ areas of the Northern, Southern, Coastal, and High Use Forest Districts. In addition, the project will identify current fire hazard and risk for all WLPZ areas vegetation cover, and provide a county-level analysis of the change in forest cover for all WLPZs areas within Plumas County.

- D. Managing forest structure and stocking standards to promote wildfire resilience?
- E. Achieving post-fire recovery and restoration?
- F. Mitigating or reducing the cumulative impacts of post-fire recovery and management actions in affected watersheds?

Theme 12 - Resilience to Disturbance in a Changing Climate

We will address project theme 12 by investigating vegetative response to past wildfires and post fire recovery actions (tree removal, reforestation) as well as current risk of WLPZ to potential future crown fire, likely to result in high severity in forest types.

- A. Improving overall forest wildfire resilience and the ability of forests to respond to climate change (e.g., in response to drought or bark beetle; reducing plant water stress) and variability, and extreme weather events (evaluate ecosystem functional response to fuel reduction and forest health treatments)?
- B. Maintaining conifer and broadleaf stands which are well adapted to climate in order facilitate riparian functions (e.g., shade, temperatures, primary productivity, stream flow)?
- C. Meeting ecological objectives and adaptation to future climate (e.g., resilience of wildlife habitats; variable retention silviculture as it relates to wildlife habitat structures)?
- D. Maintaining or recruiting adequate amounts of early- and mid-seral wildlife habitats which are well adapted to future climate?

VII Requested Funding

FY 2023-2024	FY 2024-2025
6 months: from 01/01/2024-06/30/2024	1 year: from 07/01/2024-06/30/2025
\$15000	\$25000

Justification of Costs

All funding will be used to cover staff labor costs for GIS, UAV, and other field work for FY23-24 and FY24-25.

Personnel: \$15,000 in FY23-24 and \$25,000 in FY24-25

Project staff will include two Registered Professional Foresters: Project lead, Jason Moghaddas (#2774) and Field lead Gary Roller (#2899); two licensed UAV Pilots: Jarrett Barbuto (Remote Pilot Certificate #3951206) and Travis Freed (Remote Pilot Certificate #3996768); one Fire Ecologist: Ian Moore.

Billing Rates:

Billing rates for staff will be \$\$45-\$65/hour plus fringe and indirect rates (below).

Fringe (payroll taxes, health, dental, and vision): 25 %

Travel: \$0 All travel will be contributed

Contributed Funds: Travel costs will be covered as an in-kind contribution from SIG. SIG will be contributing \$500 in FY23-24 and \$1,000 in FY24-25 for travel costs. The Post Wildfire Vegetation Mapping System was funded by NASA at a cost of \$125,000.

Equipment and Other Direct Costs: \$0 All equipment and other direct costs will be contributed

All field equipment, UAVs, software, and data will be provided by SIG at no additional cost to the project.

Indirect Costs: 15 %