Effectiveness Monitoring Committee

Initial Concept Proposal

Date Submitted: May 15, 2026

Project Title:
Evaluating Hydrologic Responses to Process-Based Meadow Restoration and Forest Thinning Treatments in Sierra Nevada Headwater Watersheds

Project #: (to be assigned by EMC)

Principal Investigator(s):
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Applying Organization:
Trout Unlimited

Collaborators:
Trout Unlimited Conservation Hydrology Program (Mia Van Docto, Troy Cameron, Anthony Modena, Abel Cameron), Trout Unlimited Inland Trout Program (Jessica Strickland, Katie Smith, Alec Leonardini, Nick Webber), U.S. Forest Service.

Project Description

Project Duration

Winter 2026 - March 2029

Background and Justification

Headwater meadows in the Sierra Nevada provide critical ecosystem services including water storage, groundwater recharge, baseflow maintenance, sediment retention, and wildfire resilience. Over the past decade, numerous meadows on U.S. Forest Service lands have been restored using process-based restoration approaches designed to reconnect incised channels to floodplains, raise groundwater levels, and increase soil moisture and vegetative productivity.

These restored meadow systems are now entering a new management phase. Forest thinning treatments are being proposed within and adjacent to meadow complexes to reduce fuel loads, improve forest health, and enhance wildfire resilience, in accordance with Forest Practice Rules. Additional thinning treatments are planned across surrounding watersheds as part of broader U.S. Forest Service vegetation management and fuels reduction programs.

While both meadow restoration and forest thinning are widely implemented management practices, there remains substantial uncertainty regarding their combined hydrologic effects at the meadow and watershed scale. More research is needed on the effects of combined restoration and thinning on groundwater level and stream baseflow persistence, particularly a setting with high climate variability such as the southern Sierra Nevada.

Long-term hydrologic monitoring is essential to quantify these responses and provide empirical data to inform adaptive management and regulatory frameworks governing forest and watershed management.

This project will continue existing groundwater and streamflow monitoring networks across a group of restored U.S. Forest Service meadows to evaluate the effectiveness of process-based restoration and forest thinning treatments in improving watershed function and climate resilience.

Objectives and Scope

The primary objective of this project is to evaluate the hydrologic response of restored meadow systems to forest thinning treatments at meadow and watershed scales.

Specific objectives include:

1. Quantify changes in groundwater levels and evaluate streamflow timing and baseflow persistence following forest thinning treatments in restored meadow systems
2. Compare hydrologic response between restored meadow systems with and without forest thinning treatments
3. Continue to compare hydrologic response of meadow systems pre- and post-restoration in systems without forest thinning treatments.
4. Evaluate the effectiveness of specific California Forest Practice Rules related to vegetation management, fuel reduction, and watershed protection in maintaining hydrologic function and meadow resilience

Study Area and Treatment Design

The proposed study will evaluate hydrologic responses across a network of restored meadow systems located in the southern Sierra Nevada (Figure 1).

Two treatment categories will be monitored:

Restored Meadows with Forest Thinning Treatments

These meadows are located within the Fish Creek watershed in the Sequoia National Forest, where meadow restoration has been completed under the Sequoia 10 Project. Forest thinning treatments are proposed for summer of 2027 within meadow perimeters to remove encroached conifers on four previously restored meadows. The proposed thinning will improve forest health by reducing forest fuel loads, reducing density of fire sensitive trees and promoting uneven

stands. Fuels thinning will complement the large-scale commercial thinning operations occurring concurrently via the Sequoia National Forest Rock Project (Project 66091); hydrologic effects from this project will be examined in place of the proposed TU thinning should this work not be funded. All treatments will be implemented consistently with vegetation management and watershed protection requirements under the California Forest Practice Rules.

Restored Meadows without Thinning Treatments (Reference Sites)

These meadow systems are located on the Kern Plateau within the Sequoia and Inyo National Forests, including the Golden Trout Wilderness, where process-based restoration is underway but forest thinning treatments will not occur due to wilderness management and other constraints. These sites provide an important reference condition to evaluate the hydrologic response to restoration alone and to isolate the effects of vegetation management treatments.

This paired design allows for evaluation of:

- Meadow restoration effects
- Forest thinning effects
- Combined restoration + thinning effects

The use of treated and untreated watersheds provides a quasi-experimental framework to evaluate the effectiveness of forest management practices under varying treatment conditions and to generate findings applicable to forested headwater systems across California.

Research Methods

Trout Unlimited's hydrologic effectiveness monitoring of restored meadows began in 2018 under the Sequoia 10 Meadows Project, and expanded significantly with the Kern Plateau Meadows project in 2023. These project's protocols for intensively monitored meadows includes monitoring of several key indicators of meadow health, including baseflow quantity and duration, surface water temperature and water table level. To monitor these indicators, Trout Unlimited's Conservation Hydrology program has been conducting streamflow and/or groundwater monitoring in eleven meadows, and monitoring will continue under this project.

Streamflow gaging stations collect continuous stage data, which when combined with manual streamflow measurements will be used to determine baseflow quantity and duration. Stream gaging equipment also collects continuous temperature data, and at some sites, conductivity data, which can be used to infer streamflow inputs and floodplain connectivity. Gaging stations were placed in pools that hold water late into the dry season, in locations protected from high flows, within protective casing, in areas that flow paths converge and ideally in areas in which valley constrictions force water to the surface to enable measurement. Gaging stations consist of a pressure transducer (PT) logging these data in 15-minute intervals, accompanied by a staff plate for calibration, and sometimes a camera to visualize inundation.

Groundwater piezometers characterize groundwater level over space and time. These wells were augured by hand with a 3” diameter soil auger, and fitted with 2” screened drive points and galvanized steel pipe casings, as described in the SM-WRAMP Groundwater Monitoring Protocol. Borings were packed with sand and capped with bentonite. Each well is equipped with a pressure transducer recording continuous hourly ground water level data. Pressure transducers will be added to piezometers that currently allow for manual measurements only.

Effectiveness Monitoring Committee funding will allow for continuation and expansion of an established monitoring program, and allow for analysis of data to be expanded and published in a scientific journal, as well as presented at conferences.

Scientific Uncertainty and Geographic Application

Despite widespread implementation of meadow restoration and forest thinning treatments across California, substantial uncertainty remains regarding their cumulative hydrologic effects at the watershed scale.

Key uncertainties addressed by this project include:

- How forest thinning treatments influence groundwater recharge and storage
- Whether vegetation management improves or reduces late-season streamflow
- How combined restoration and thinning treatments affect drought resilience
- The magnitude and duration of hydrologic response to vegetation management conducted under existing forest management regulations

Results from this project will be broadly applicable to forested headwater systems across California, particularly in the Sierra Nevada and other montane regions where meadow restoration and fuels reduction treatments are widely implemented.

Collaborations and Project Feasibility

Existing monitoring infrastructure, datasets, and field protocols are already in place at the proposed study sites, enabling immediate project implementation and reducing startup costs.

Long-term monitoring capacity and established partnerships with the U.S. Forest Service ensure project feasibility and continuity through the project period.

Critical Question Themes and Forest Practice Rules Addressed

This project directly evaluates the effectiveness of vegetation management and restoration practices governed by the California Forest Practice Rules (FPRs). The proposed monitoring will generate empirical data to assess whether current forest management practices protect

watershed function, maintain meadow hydrology, and support ecosystem resilience following vegetation treatments.

Relevant Forest Practice Rules include:

Watercourse and Lake Protection Zones (WLPZ)

14 CCR §§ 916 / 936 / 956

These rules establish requirements to protect riparian and meadow ecosystems, maintain hydrologic function, and minimize disturbance near watercourses. This project will evaluate whether vegetation management adjacent to restored meadow systems maintains groundwater levels and streamflow persistence consistent with WLPZ protection objectives.

Fuel Reduction and Vegetation Management within WLPZs

14 CCR §§ 913.3 / 933.3 / 953.3

These rules allow vegetation management within riparian and meadow environments to reduce fuel loads while requiring protection of water quality and watershed function. This project will evaluate whether thinning treatments implemented under these provisions maintain hydrologic function and watershed resilience.

Forest Structure and Stocking Standards

14 CCR §§ 912.7 / 932.7 / 952.7

These rules regulate stand density and vegetation management to promote forest health and resilience. This project will evaluate whether forest thinning treatments implemented to meet stocking and fuel reduction objectives influence groundwater storage and late-season streamflow persistence.

Protection of Soil and Water Resources

14 CCR §§ 916.9 / 936.9 / 956.9

These rules require management practices that minimize soil disturbance and protect watershed function. Hydrologic monitoring conducted through this project will provide measurable indicators of watershed response to vegetation management.

Requested Funding (Concept Level)

Estimated total request:

Budget Category	Year 1 Total	Year 2 Total	Year 3 Total
Staff time	$ 35,759.52	$ 73,761.74	$ 72,902.18
Staff benefits & payroll tax	$19,097.59	$35,529.46	$37,564.55
Travel and per diem	$ 1,230.00	$ 7,010.00	$ 7,010.00
Supplies	$ 17,544.00	$ 100.00	$ 100.00
Indirect	$ 8,973.94	$ 18,608.19	$ 18,796.28
Annual Total	**$ 82,605.04**	**$ 135,009.39**	**$ 136,373.01**
Project Total	**$**		**353,987.44**

Staff time includes the following tasks: 1) Field planning and preparations, training and coordination, 2) Field work, 3) Data management and analysis, 4) Reporting, publication and conference presentations, and 5) Project management, meetings and coordination.

Costs may be lower if field visits can be combined with other project-related field visits, efforts will be made to do so. In-kind contributions will include staff time and monitoring infrastructure.

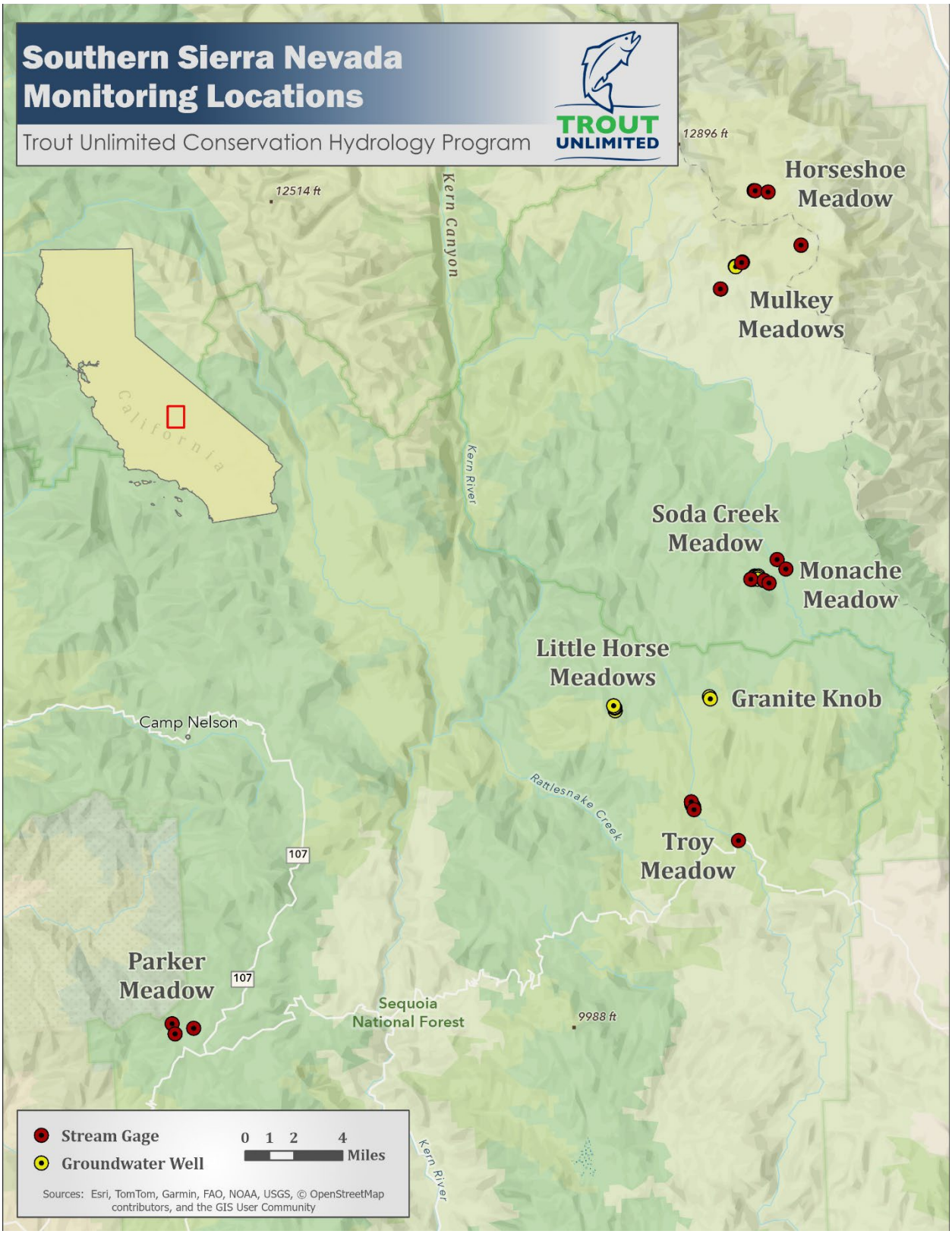

Figure 1. Existing southern Sierra gage and groundwater monitoring locations, for evaluating hydrologic responses to meadow restoration and forest thinning treatments.

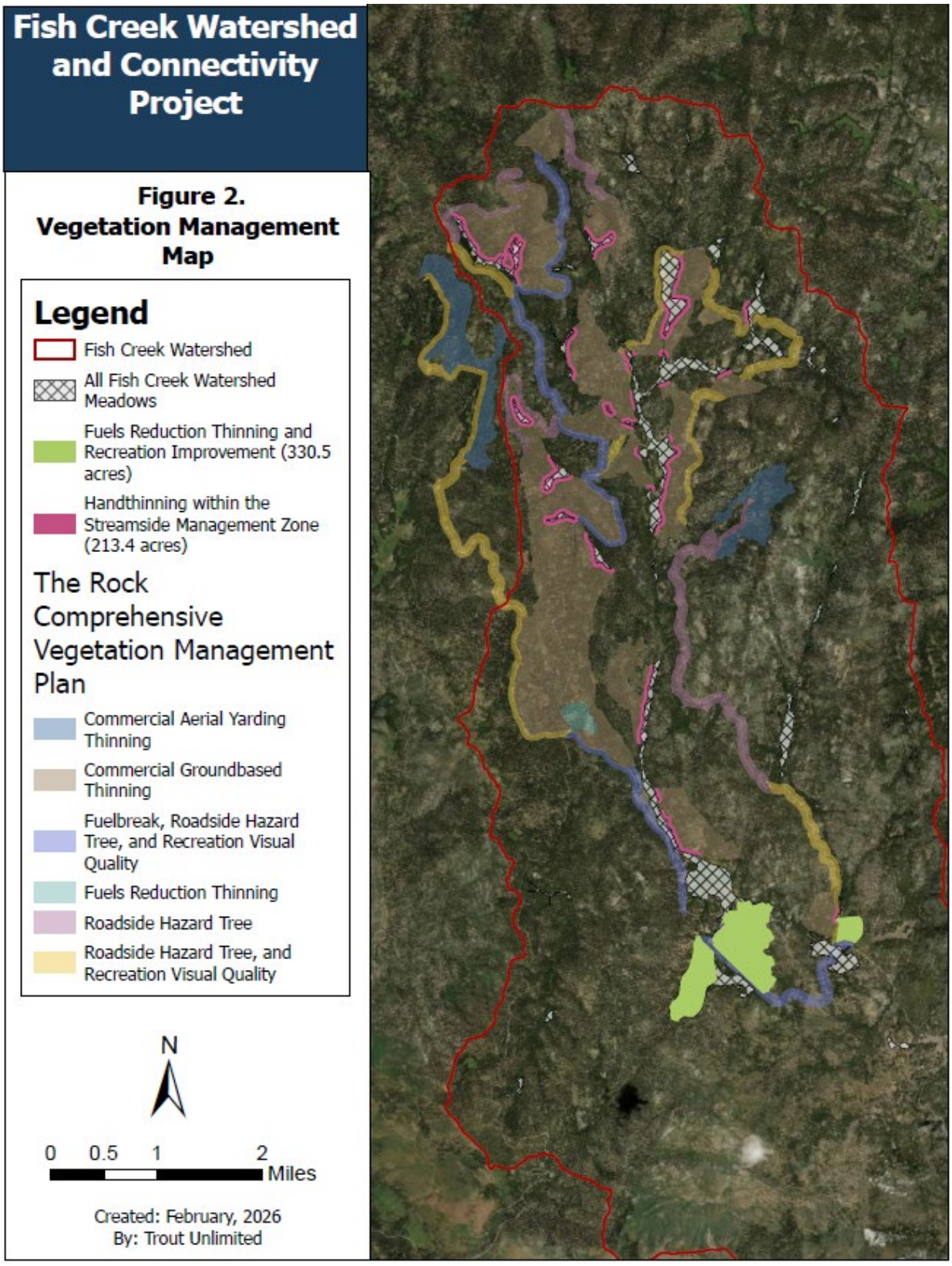

Figure 2. Overview of proposed forest thinning treatments, Fish Creek watershed, Sequoia National Forest.