

CALIFORNIA
WILDFIRE
& FOREST
RESILIENCE
TASK FORCE

CALIFORNIA'S REFORESTATION STRATEGY

AN ALL-LANDS APPROACH TO RESTORING FORESTS AFTER SEVERE WILDFIRE

OCTOBER 2026

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Lead Authors

Madeline Sides, Ph.D., Ning Zhang, Ph.D., Jennifer Smith, and Steven Ostoja, Ph.D., USDA California Climate Hub

Co-Authors

Shelley Villalobos, Leana Weissberg, and Britta Dyer from American Forests, Topher Byrd, Stewart McMorrow, and James Scheid from CAL FIRE, and Brandon Collins, Ph.D., Malcolm North, Ph.D., and Dana Walsh from the USDA Forest Service.

About this Document

The best available science, data, and modeling techniques were used in developing this strategy. The findings and management applications presented are informed by the expertise and experience of those involved in the strategy development. In addition to the authors and co-authors named above, members of the Task Force Science Advisory Panel and reforestation working group provided input on the selection and application of data and analysis techniques. We thank Nic Enstice, Nadia Tase, and Jonathan Long, Ph.D., for providing draft review and comments.

This document is an interagency strategy, or "shared strategy", one of several overseen by the California Wildfire and Forest Resilience Task Force. It is intended to support agency and partner efforts to advance reforestation programs and initiatives. The USDA California Climate Hub developed this document in partnership with CAL FIRE, the USDA Forest Service, and American Forests to inform the California Wildfire and Forest Resilience Task Force Action Plan (2026-2031). It has been crafted as a decision- and policy-enabling strategy consistent with current State of California and U.S. Department of Agriculture priorities. Although we believe this document to be the first all-lands reforestation strategy developed for California, we drew on prior content produced by the Task Force reforestation working group, other peer-reviewed products, and additional state and federal government reports.

Cover Image

Staff from the USDA Forest Service and Agricultural Research Service, CAL FIRE, UC Agriculture and Natural Resources, UC Cooperative Extension, and private timber companies gather at a site burned in the 2021 Dixie Fire to discuss post-wildfire reforestation practices. Photo by Madeline Sides, USDA California Climate Hub.

EXECUTIVE SUMMARY

Millions of acres of California's forests and woodlands are threatened by high-severity wildfires. Beyond the risks to iconic species like the giant sequoia, the short and long-term effects of these wildfires put ecosystem services such as water supply, wildlife habitat, timber provisioning, carbon storage, and recreation at risk. Reforestation provides an effective means to recover forests after disturbances such as wildfires.

Building on California's 2021 Wildfire and Forest Resilience Action Plan, this statewide reforestation strategy provides a roadmap to restore and recover California's forests that have experienced high-severity fire and may be limited in natural recovery. This strategy presents the extent of wildfire-driven reforestation needs from 2000 to 2024, estimated needs for the next 10 years, the area reforested since 2020, and the current reforestation gap, or the difference between the amount of reforestation needed and the amount accomplished. To reduce the reforestation gap, this strategy describes various accomplishment scale-up trajectories, outlines a three-tiered approach to prioritizing reforestation treatments in post-fire landscapes, and proposes key actions aligned with four goals.

A Landscape in Transition: California's Reforestation Needs: Reforestation has been practiced in California for over a century but reforesting at a pace and scale that can effectively address the impacts of large and high-severity wildfires is relatively new and poses serious operational challenges.

- The footprint of reforestation needs from high-severity wildfires since 2000 spans **2.3 million acres** of California's forestlands.
- Roughly **70% (1.6 million acres)** of these needs are attributable to high-severity wildfires from 2020 to 2024.
- High-severity wildfire modeling suggests that, by 2034, an additional **1.7 – 2.2 million acres** may need to be reforested.

Reforestation Activity is Not Keeping Pace: Across the state, hundreds of thousands of acres have been reforested since 2020, but millions of acres of forest have been severely impacted by wildfire. As a result, between one and two million acres of burned forests are at risk of type conversion, meaning a permanent transition of forests into shrublands or grasslands.

- Statewide, **~16%** of the acres that burned at high severity since 2020 and are unlikely to regenerate naturally have been reforested.
- On **federal lands** outside of wilderness areas, **~8%** of severely burned forestland has been reforested since 2020.
- Reforestation needs are greatest in **Sierra Nevada** and **Northern California forests**, though there are also reforestation backlogs in Southern and Central California.

The Investment Challenge: Accelerating and increasing reforestation efforts in California to meet the scale of existing and anticipated wildfire impacts will require significant increases in capacity and funding. Reforestation is a multi-step process that often requires multiple treatments beyond planting tree seedlings. This means that total per-acre reforestation expenses depend on site accessibility, labor availability, and the extent of site preparation required before tree planting. To meet the State's nature-based solution targets, currently California's only state-specific and statutorily established reforestation goals, starting with 280,000 ac/yr by 2030, would require:

- **Scaling up** reforestation accomplishments at a growth rate of 35% annually from 2026 to 2030.
- Developing extensive **implementation partnerships** to get more work done on federal lands.
- Committing significant funds, as reforestation costs can range from **$1,850 to $6,400 per acre or more.** Generally, when more time passes after a fire, the cost and effort required to reforest is greater.

Strategic Prioritization to Maximize Benefits: The effectiveness and benefits of strategic reforestation can likely be augmented through a three-tier approach that prioritizes activities to maximize human safety, ecosystem function, and ecological benefits:

- Tier 1: Critical Human Safety Concerns and Ecosystem Services: Opportunities to enhance post-fire public safety near communities, and critical ecosystem services such as water supply.
- Tier 2: Important but Non-Safety-Critical Ecosystem Values: Ecosystem restoration opportunities as well as opportunities to protect and enhance other ecosystem services not immediately critical for human safety such as recreation.
- Tier 3: Situational Opportunities: Sites and areas to expand acreage where an amplification of benefits from tier 1 or 2 could be realized.

A Collective Path to Close the Reforestation Gap: To address the millions of acres of reforestation needs in California's burned forestlands, managers and forest owners must be able to plan and implement long-term and climate-informed projects that span the reforestation pipeline, from seed collection to post-planting maintenance. This strategy proposes key actions oriented around four goals to scale up and enable climate-informed, strategically prioritized reforestation:

- **Goal 1: Increase the Efficiency and Pace of Reforestation Planning**
  Encourage pre-fire planning, provide regulatory relief, such as by including post-fire reforestation in emergency declarations and categorical exclusions, expand access to and options for collecting planning data, such as by including reforestation scoping and data curation during active wildfire incidents, and implement the proposed three-tier prioritization scheme to focus effort on areas most likely to offer long-term benefits.

- **Goal 2: Enhance Supplies of Reforestation Planting Materials**
  Develop an all-lands seed strategy to ensure high-quality seedlings are available and sustain existing investments in the plant materials workforce.

- **Goal 3: Increase Capacity for Reforestation Implementation**

Continue to develop a skilled and abundant workforce through education and expanded funding channels, including leveraging the REPLANT Act, federal-state partnerships, and public-private partnerships to address budget and capacity shortfalls.

- **Goal 4: Expand the Adoption of Climate-Informed Reforestation Practices**
  Adopt new institutional practices to ensure young forests survive a warmer, drier climate and equip land managers with climate-appropriate planting data and direction.

Increased and sustained investment in reforestation can help mitigate the impacts of high-severity wildfires on California's forests and the ecosystem services that they provide. Reforestation efforts can be costly and are not always successful long-term, underscoring the importance of pre-fire forest health treatments to moderate wildfire impacts and the need to reforest severely burned areas. By not only scaling up but also strategically prioritizing reforestation efforts, we can work collectively to protect long-term forest cover in California.

INTRODUCTION

Wildfire is an important ecological process that benefits ecosystem health and resilience. In California, as in many other regions globally, the annual area burned and the fraction burning at high severity have increased in recent years. Multiple factors have contributed to larger and more severe wildfires, including historical land uses, longstanding fire suppression policies, patterns of human development, and warmer and drier conditions associated with a changing climate. Consequently, forests' natural regeneration processes are being overwhelmed in large areas of high-severity wildfire, driving forest cover losses, and in some cases facilitating vegetation type changes (i.e., conversion of forests to shrublands or grasslands) at an unprecedented rate. When implemented promptly following fire, and using appropriate methods, reforestation can mitigate post-wildfire impacts by reducing future wildfire hazard potential and restoring forest cover lost to wildfire.

The second-growth conifer forests found across California are the result of natural regeneration and reforestation efforts in the late 1800s and early 1900s, when the state had a very active forest products economy. While the forest product sector in California is still engaged in active reforestation and post-fire recovery work on the lands they own and manage, the contraction of the sector in the late 20th century led to a substantial loss of statewide reforestation capacity. Even though reforestation has been practiced continuously in California for over a century, reforesting the vast areas across the state affected by recent large, high-severity wildfires requires far more reforestation capacity than is currently available.

This reforestation capacity gap is not unique to California; nearly every wildfire-prone region of the Western U.S. faces a shortfall. Dobrowski et al. (2024) report that between 1984 and 2021, annual tree planting capacity across the Western U.S. fell short of wildfire-driven needs by 3.8 million acres and predict a 2-to-3-fold growth of this gap by 2050. With millions of acres of forest across the Western U.S. that need to be reforested, limited capacity is not the only challenge. Reforestation implementation costs start at approximately $1,850 per acre and can be >$6,400 an acre, meaning that reforesting even a modest portion of wildfire-affected landscapes across the Western U.S. will require multi-billion-dollar investments. Scaling reforestation is a national priority; the 2021 federal REPLANT Act calls on the National Forest System to increase its reforestation capacity and accomplishments, and the USDA Forest Service 2025 National Active Forest Management Strategy includes a section on accelerating, expanding, and modernizing reforestation processes.

Recognizing that post-wildfire reforestation is an essential management activity to reduce both forest loss and the potential for hazardous, repeated high-severity burns, the California Wildfire and Forest Resilience Task Force convened a reforestation working group in 2021 to collaboratively advance the reforestation priorities of multiple agencies. The working group was led by USDA Forest Service and CAL FIRE, with facilitation by American Forests and participation from the USDA Forest Service PSW Research Station, USDA Forest Service Region 5, USDA California Climate Hub, UC Agriculture & Natural Resources, UC Cooperative Extension, CAL FIRE Reforestation Services Program, Bureau of Land Management, and CA Association of Resource Conservation Districts. In 2023, the working group produced an assessment on filling

critical gaps in California's reforestation pipeline that drew attention to the need to enhance and expand the supply of reforestation plant materials in California and has informed multiple programs and strategies in recent years.

This 2026 strategy document builds directly on concepts and approaches established in the working group's assessment, offering an updated analysis of both the reforestation challenges in California and the strategic actions and solutions needed to address them. This strategy can also support the State's nature-based solutions targets, which call for a significant increase in post-wildfire reforestation, as well as other forest restoration, between 2030 and 2045. The quantitative approach we used to determine statewide needs as well as the goals and key actions we synthesized were informed by collaborating with co-authors and consulting with staff from multiple state and federal agencies and NGOs. This strategy (1) identifies the current extent of wildfire-driven reforestation needs, (2) assesses recent reforestation accomplishments, and (3) determines the current reforestation gap, which is the difference between needs and accomplishments. Building from this information, we also (4) discuss considerations for closing the gap, including scenarios for scaling up treatments and a strategic framework for prioritizing reforestation, and (5) describe key actions to address California's reforestation challenges.

1. WILDFIRE-DRIVEN REFORESTATAION NEEDS IN CALIFORNIA

Background

Reforestation is needed to sustain future forest cover when the rate and scale of tree mortality exceed an area's natural regeneration capacity. Tree mortality from timber harvest, drought, disease, pests, and wildfire can all prompt the need to reforest. Over time, and particularly following high-severity wildfire, widespread tree mortality can cause a forest to undergo a permanent type conversion to shrubland or grassland. Sites that burn initially at high severity and do not receive post-wildfire fuels treatments can burn multiple times at high severity, making recovery more difficult and type conversion more likely.

Post-wildfire forest loss and repeat high-severity burns affect people and wildlife in multiple ways. Healthy forest cover stores carbon, provides wildlife habitat, influences snowpack accumulation and melt, and supports sustainable timber harvest and recreational use. When non-forest vegetation types like shrubs and grasses replace forests at scale, and particularly when that replacement is spurred by high-severity wildfire, multiple ecosystem services are degraded. High-severity wildfire not only threatens human communities and infrastructure, but also damages soil, kills trees, and sets the stage for dangerous post-wildfire debris flows, among other effects. Repeat high-severity burns intensify these impacts.

Reforestation can mitigate the worst potential outcomes of high-severity wildfires. A typical sequence of post-wildfire reforestation begins with removing hazard trees, remnant fuels and competing vegetation from a burned area, followed by planting young seedlings and years of post-planting maintenance work such as vegetation removal and stand thinning, as needed. When young forests are established in densities and arrangements that are appropriate to current and future site conditions and receive ongoing maintenance treatments and beneficial fire, healthy and resilient forest recovery can eventually occur. To plan, fund, and execute successful reforestation programs and projects, we must know which areas of burned forestlands need to be reforested. The subsequent sections of this strategy focus on identifying areas across California where, without management action, conifer cover may be lost.

Methods, Data, and Analyses

Identifying Wildfire-Driven Reforestation Needs, 2000 - 2024

Active reforestation may be needed to restore forest cover in areas where natural regeneration processes are expected to fail or be insufficient following tree-killing disturbances. While various management activities and disturbance types may necessitate reforestation, the focus of this strategy is reforesting wildfire-affected landscapes that may never recover on their own. We assume that the primary limiting factor to post-wildfire natural regeneration is a scarcity of naturally occurring seed (i.e., too few seed-producing living trees close to burned areas), though other processes can affect natural regeneration, including low soil moisture and competing vegetation. This analysis assumes previously forested areas within high-severity wildfire patches located outside the seed dispersal range of nearby living trees will not recover without management action. Importantly, our intent is to identify areas where wildfire impacts

may result in the loss of non-resprouting conifers, not necessarily to prescribe where and how forests should be replanted.

We used remotely sensed wildfire data from 2000 to 2024 to identify the size and location of wildfire-affected areas in California's conifer forests and woodlands that need to be reforested. We report results in two periods: 2000 to 2019 and 2020 to 2024. These periods were used because it becomes more difficult and costly for managers to reforest when more than five years have passed since a wildfire. We acknowledge that the recent historical baseline extent of conifer forests across California is likely higher than it was prior to Euro-American settlement due to decades of fire exclusion and conifer encroachment.

A statewide map layer covering all reforestation-relevant forest areas was developed using the FVEG15 dataset from the California Department of Forestry and Fire Protection (CAL FIRE) Fire and Resource Assessment Program. Conifer forest and conifer woodland cover types were included because these forest types are generally not adapted to regenerate naturally following high-severity wildfire. Coast redwood and aspen subclasses within these categories were excluded because, although they may benefit from post-wildfire restoration treatments, redwoods and aspens can resprout following high-severity wildfire and typically do not require the full suite of reforestation treatments.

Wildfire perimeters were obtained from the federal interagency Monitoring Trends in Burn Severity (MTBS) database, which provides spatially explicit perimeters for all U.S. fires >1,000 acres. We used MTBS perimeters for our analyses from 2000 to 2023. Because MTBS perimeters were unavailable for 2024 (period of this analysis), we used perimeters from the CAL FIRE Historical Fire Perimeter dataset for 2024, filtered to include events >5,000 acres. Only fire-affected areas intersecting the forest map layer were retained for analysis. Fire events not classified as wildfire (e.g., prescribed fire) were omitted.

Fire perimeter data were combined with Landsat data in Google Earth Engine to classify burned areas by severity. We adopted the burn severity classes following Parks et al. (2019), using three ranges of bias-corrected Composite Burn Index (CBI). The unburned-to-low severity class is defined as CBI < 1.25, moderate severity as 1.25 ≤ CBI < 2.25, and high severity as CBI ≥ 2.25. CBI layers for 2000–2022 were obtained from Parks et al. (2025), and CBI layers for 2023 and 2024 were produced following the methods in Parks et al. (2019). Burn severity-classified spatial data were used to identify areas that need to be reforested by counting the number of previously forested acres that burned at high severity and are located >35 meters from the nearest two-acre or larger patch of forest that did not burn at high severity (Figure 1).

We analyze reforestation needs for each year separately and sum them to determine total needs in each period (2000-2019 and 2020-2024). We assume that any reburning occurred between periods, not within periods. In this case, reburn refers to locations where high-severity wildfires caused disturbance to a degree that necessitates reforestation more than once between 2000 and 2024. To determine the overall reburn rate, we subtracted the spatial footprint of all needs from 2000 to 2024 from the summation of annual needs in the two periods. There are likely many additional acres where wildfires occurred more than once, but we only track where wildfire-driven

reforestation needs from high-severity wildfires overlap. We use the overall reforestation needs footprint to determine total needs from 2000 to 2024.

To determine the distribution of reforestation needs by ownership and Task Force region, we used the California Natural Resources Agency's statewide land ownership dataset (*California Land Ownership*, 2025) and a 2025 version of the Task Force regional map. No operational constraints were applied to our initial analysis of wildfire-driven reforestation needs, although data from Wilderness Connect were used to identify federally designated wilderness areas, which we report separately from other federal lands.

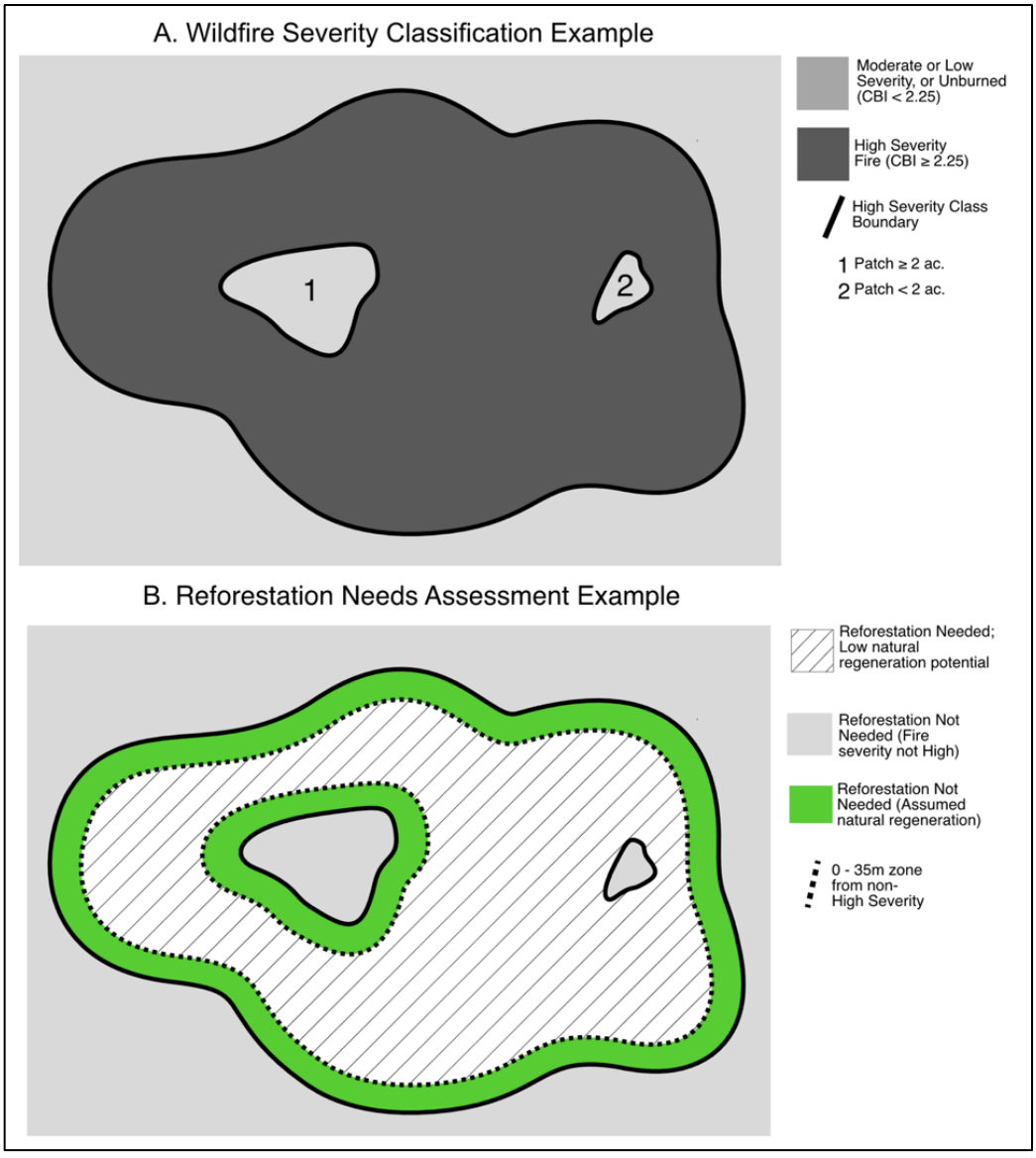


Figure 1. Identifying reforestation needs from wildfire spatial data
The hypothetical wildfire in panel A includes areas of high-severity wildfire (dark grey) amidst non-high-severity wildfire (light grey). Panel B shows how those classifications were used to identify areas where natural regeneration is likely to be insufficient (i.e., reforestation needs), with additional spatial considerations. We expect high-severity wildfire areas within 35 m (115 ft.) of forest patches larger than 2 acres that did not burn at high severity (e.g., see Patch 1 vs Patch 2) to have sufficient natural regeneration potential such that reforestation is not needed (green zones).

Projecting Future Wildfire-Driven Reforestation Needs, 2025 – 2034

We estimated future wildfire-driven reforestation needs by adapting the two-step projection framework used by Dobrowski et al. (2024). This framework incorporates the climate-fire relationship developed by Abatzoglou et al. (2021). First, we fitted a historical relationship between climatic water deficit (CWD) and annual forest area burned to project future annual forest area burned. Second, we fitted a historical relationship between annual forest area burned and annual reforestation needs to project future annual reforestation needs. Importantly, this method assumes that historical climate-wildfire and fire-reforestation-need relationships will remain applicable in the future, meaning that the projections do not account for current and future management efforts to improve forest health and moderate fire severity. The following sections describe each step in detail.

Step one entailed relating climate to annual forest area burned. We developed a California-specific version of the log-linear relationship between historical CWD z-scores and annual forest area burned that Abatzoglou et al. (2021) developed for the Western U.S. climatic water deficit (CWD), a proxy for aridity commonly used in ecological studies to indicate potential plant water stress, can be understood biologically as the gap between water available in soil and plants' atmospheric water demand. Annual CWD for 1991–2034 was calculated by summing downscaled monthly deficit evapotranspiration levels from the LOCA2 Monthly Water Balance Model for each calendar year. The period 1991-2014 served as the baseline for calculating CWD z-scores for both historical period (2000-2014) and the future period (2015-2034). We used forest fractional area to calculate area-weighted annual CWD z-scores for our forest analysis layer, which consists of California's non-resprouting conifers. These z-scores allow historical and future CWD values to be compared on the same scale.

Historical CWD z-scores for 2000–2014 were obtained from the 24-model LOCA2 historical ensemble mean. We then fitted a loglinear relationship between CWD z-score and annual forest area burned using the model form lm(log(annual area burned) ~ CWD), following Dobrowski et al. (2024). In our implementation, annual area burned refers to annual forest area burned in the included forest types, and CWD is represented by the area-weighted annual CWD z-score. The fitted coefficients were held constant when the model was applied to future years.With this modeled historical climate-wildfire relationship, we projected annual forest area burned in California using projected future CWD z-scores. Future period CWD z-scores for 2015–2034 were obtained from the 24-model LOCA2 ensemble mean under the Shared Socioeconomic Pathway (SSP) 2-4.5 scenario (Meinshausen et al., 2020). The SSP2-4.5 scenario is an intermediate scenario that assumes a middle-of-the-road pattern of socioeconomic development and a nominal radiative forcing level of 4.5 W m^{-2} by 2100. Although future CWD projections were generated for 2015-2034, the future reforestation-needs estimates reported here cover 2025-2034.

To assess sensitivity to extrapolation beyond the historical CWD range, we generated both unconstrained and variance-constrained projections. Where projected CWD z-scores were outside of the historical range by two standard deviations or more, they were we capped to two standard deviations. This represents a more conservative estimate of future conditions. We also retained the original, unconstrained CWD z-scores, which serve as less conservative estimates of future conditions. With these

variance-constrained and unconstrained future z-scores based on SSP2-4.5, we extrapolated the established climate-wildfire relationship to estimate future annual forest area burned in our forest types of interest.

Step two entailed relating annual forest area burned to reforestation needs. Using California data from 2000-2024, we fit a California-specific linear relationship between annual forest area burned and annual reforestation needs. The choice of a linear model was informed by Dobrowski et al. (2024)'s finding that the relationship is highly linear across the Western U.S. We applied the fitted California relationship to projected annual forest area burned. This produced future wildfire-driven reforestation needs for 2025 to 2034. Because wildfire datasets for 2025 are not yet complete enough to include in our historical analysis, 2025 is treated as a future projection.

For each future year, we applied the California fire-reforestation-need relationship to both the unconstrained and variance-constrained projections of annual forest area burned. When the two scenarios produced different estimates, we reported both estimates as a range. The unconstrained estimate is an upper bound and the constrained estimate is a lower bound. When no capping was triggered, the two approaches produced the same estimate and we reported a single value.

Results

Wildfire-Driven Reforestation Needs, 2000 - 2024

Across California, we identified 826,643 acres of wildfire-driven reforestation needs between 2000 and 2019. We identified 1,563,472 acres of wildfire-driven needs from 2020 to 2024. The statewide footprint of all reforestation needs between 2000 and 2024 is 2,336,255 acres, which is 53,859 acres (2%) smaller than the sum of needs in the two sub-periods due to reburn events. The annual incidence of wildfire-driven reforestation needs in California went up noticeably between the 2000 – 2019 period and the 2020 – 2024 period, from an average of 41,000 acres per year to more than 300,000 acres per year, a more than 600% increase, with much of that increase attributable to the 2020 and 2021 fire seasons. Reforestation needs are not evenly distributed across the state (Figures 2 and 3). 1 million acres, or nearly half, of the wildfire-driven reforestation needs from the 2020 – 2024 period are in the Sierra Nevada. 39% of the needs from 2020 to 2024, approximately 600,000 acres, are in Northern California. Central and Southern California account for an additional 3% of needs, totaling almost 50,000 acres. Table A1 in Appendix A presents the top 35 wildfires since 2020 in terms of fire-related reforestation needs, including a list of the counties that intersect with the footprint of each fire's reforestation needs. The spatial data associated with these results can be accessed for download at https://reforestationtoolshed.com/data/.

Table 1. Estimated statewide wildfire-driven reforestation needs and accomplishment by Task Force region
Section A reports the estimated total acreage of reforestation needs from the 2000-2019 and 2020-2024 periods, including wilderness. Because some acres burned more than once between 2000 and 2024, the reforestation needs footprint from 2000 to 2024 is 2% smaller than the sum of the two periods, and totals 2,336,255 acres.
Section B reports the estimated annual reforestation extent by region in the 2020 to 2024 period based on data from the Interagency Tracking System. Throughout this analysis, tree planting acres reported with reforestation as the primary objective serve to estimate the annual regional reforestation footprint. Half of the reported acres lack spatial information and are tabulated as "No Region Identifiable". As such, we do not report region-specific gaps. Operability has not been factored into any data reported in this table.

A. Estimated Statewide Reforestation Needs 2000 - 2024

	No. California	Sierra Nevada	Central California	So. California	Total
2000–2019 (ac.)	368,419	385,922	26,363	45,939	826,643
(Regional %)	(44%)	(47%)	(3%)	(5%)	
2020–2024 (ac.)	604,597	909,827	21,293	27,754	1,563,472
(Regional %)	(39%)	(58%)	(1%)	(2%)	

B. Estimated Area Reforested 2020 - 2024

	No. California	Sierra Nevada	Central California	So. California	No Region Identifiable	Total
2020 – 2024 (ac.) Reported in ITS	21,995	58,376	1,019	10,894	161,988	254,272

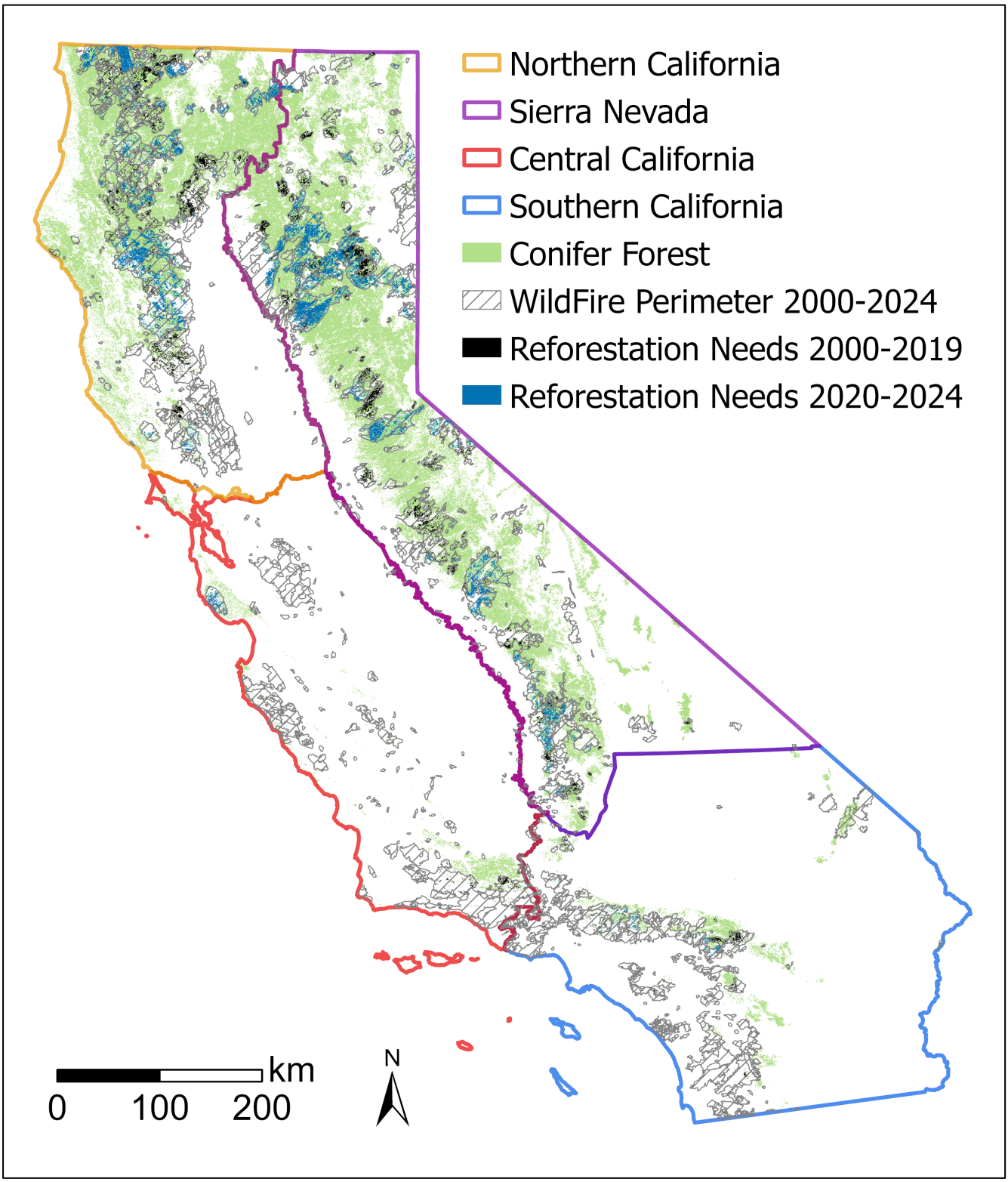


Figure 2. Reforestation needs by Task Force region, 2000 – 2024
All wildfire perimeters >1,000 acres (excluding prescribed fire) since 2000 are outlined in grey, with areas that need to be reforested indicated in black for 2000 to 2019 and blue for 2020 to 2024. For 2024, only wildfire perimeters >5,000 acres are included. Across as many as 53,859 acres, wildfires severe enough to necessitate reforestation affected the same location more than once in the 2000 – 2024 period. These spatial data can be accessed for download at https://reforestationtoolshed.com/data/.

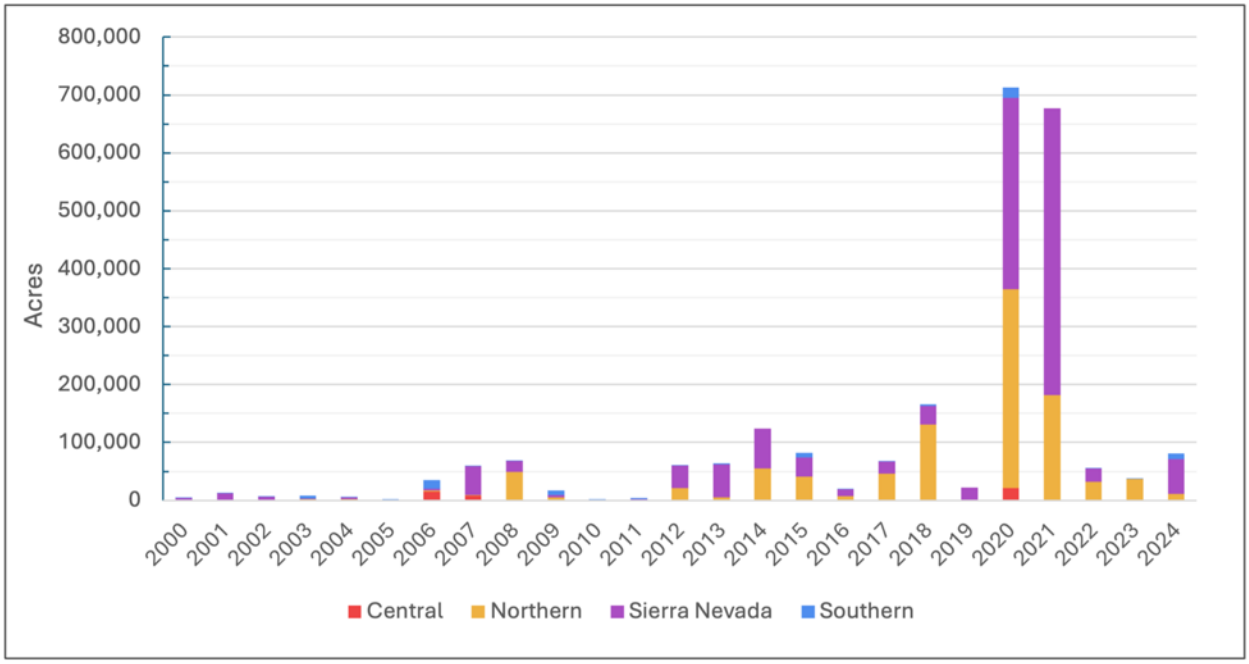


Figure 3. Annual wildfire-driven reforestation needs by Task Force region 2000 – 2024
The stacked bar chart indicates the regional distribution of annual wildfire-driven reforestation needs. Each bar reports just the reforestation needs related to that year's wildfires and does not account for reforestation treatment activity.

Reforestation Needs in Federal Wilderness Areas

Segmenting statewide reforestation needs by ownership, as shown by Table 2 and Figures 4 and 5, illustrates new facets of the challenges and opportunities associated with reforesting California. 78% of the statewide forest area not expected to naturally regenerate due to high severity wildfires since 2000 are on federal lands. 64% of statewide reforestation needs since 2000 are on federal non-wilderness lands (approximately 1.5 million acres). Approximately 350,000 acres of forest affected by wildfires since 2000 that are not expected to regenerate naturally, nearly 15% of the statewide total, are in federally designated wilderness areas. Wilderness needs are reported in their own category in Table 2, separate from non-wilderness federal lands, because of their unique status and the associated implications for reforestation. Federal wilderness areas, under the Wilderness Act (1964), are protected from many forms of development, mechanization, and resource extraction. While reforestation projects can be designed to comply with the Wilderness Act, reforestation in designated wilderness areas has been extremely limited. Wilderness is included in this reforestation needs analysis to document and track the extent of forests in wilderness at risk of loss from post-wildfire natural regeneration. Burned areas in wilderness may be extremely difficult to treat, regardless of their regulatory status, because they are typically roadless and infrastructure-free. The challenges of scaling reforestation in wilderness areas underscores the importance of sustaining and as needed, restoring the health of forests adjacent to wilderness areas to protect them from high-severity wildfires.

Table 2. Estimated statewide wildfire-driven reforestation needs, area reforested, and gap size by ownership

Section A is ownership-based estimates of reforestation needs in the 2000 – 2019 and 2020 – 2024 periods, which were determined by applying each group's portion of annual high-severity wildfire, which was derived through our spatial analysis, to the annual statewide reforestation need. Because some acres burned more than once between 2000 and 2024, the reforestation needs footprint from 2000 to 2024 is 2% smaller than the sum of the two periods and totals 2,336,255 acres. In **Section B**, tree planting acres reported to the Interagency Tracking System with reforestation as the primary objective serve to estimate the annual reforestation footprint by ownership category. We assume that negligible amounts of treatments have occurred in wilderness areas. In **Section C**, totals from Sections A and B are compared to estimate untreated reforestation needs by ownership from 2020 to 2024. Each ownership's gap percentage (i.e., the portion of an ownership's needs that remains untreated) is presented in parentheses.

A. Estimated Reforestation Needs 2000 - 2024

	Fed Non-Wild.	Fed Wild.	State	Pvt Ind.	Pvt. Non-Ind.	Tribal	Local	NGO	Total
2000–2019 (ac.)	490,093	139,813	8,744	92,659	86,122	1,079	690	7,442	826,643
(% of period total)	(59%)	(17%)	(1%)	(11%)	(10%)	(<1%)	(<1%)	(<1%)	
2020–2024 (ac.)	1,037,622	207,723	13,848	172,610	123,121	3,344	1,308	3,896	1,563,472
(% of period total)	(66%)	(13%)	(1%)	(11%)	(8%)	(<1%)	(<1%)	(<1%)	

B. Estimated Area Reforested 2020 - 2024

	Fed Non-Wild.	Fed Wild.	State	Pvt Ind.	Pvt. Non-Ind.	Tribal	Local	NGO	Total
2020 – 2024 (ac.)	78,306	-	3,033	162,146	10,413	65	237	73	254,272

C. Estimated Reforestation Gap 2020 - 2024

	Fed Non-Wild.	Fed Wild.	State	Pvt Ind.	Pvt. Non-Ind.	Tribal	Local	NGO	Total
2020 – 2024 (ac.)	959,316	207,723	10,814	10,465	112,708	3,279	1,071	3,823	1,309,200
(Ownership's Gap as % of Ownership's Needs)	(93%)	(100%)	(78%)	(6%)	(92%)	(98%)	(82%)	(98%)	(84%)

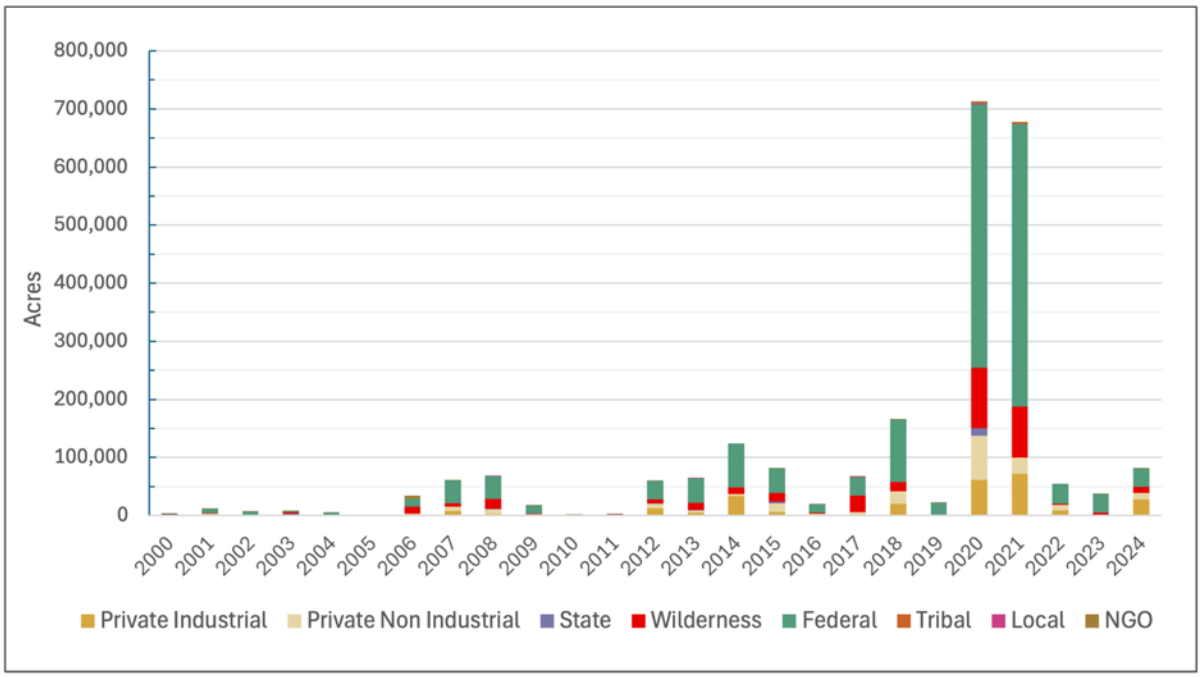


Figure 4. Estimated annual wildfire-driven reforestation needs by ownership, 2000 - 2024
The stacked bar chart indicates how annual reforestation need totals are distributed among the different ownership groups in California, with a large portion of need on federal lands (purple) and in the extreme fire years 2020 and 2021.

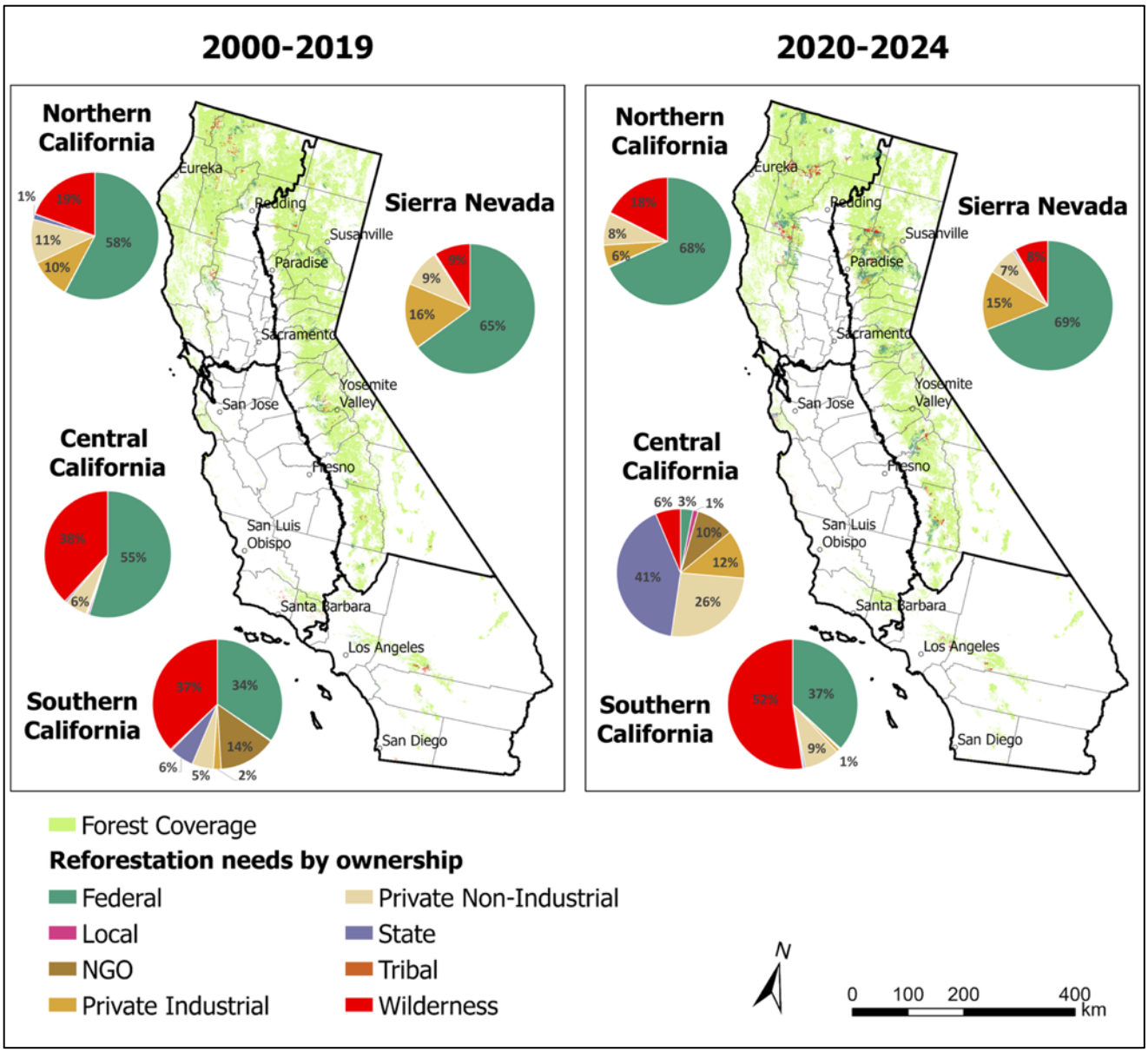


Figure 5. Reforestation needs by ownership and region, 2000 – 2019 and 2020 - 2024

Wildfire-driven reforestation needs are identified for the 2000 – 2019 period (left map panel) and 2020 – 2024 period (right map panel), with ownership-based color coding and a light green base layer for the forest extent included in the analysis. Pie charts within the map panels show the portion of a region's reforestation needs by ownership in each period. Dark green federal needs are exclusively those outside of federal wilderness areas. Areas of federal wilderness that are unlikely to naturally regenerate are shown in red. Regional reforestation needs acreage totals are as follows: in Northern California, 368,419 acres from 2000 to 2019 and 604,597 acres from 2020 to 2024, in the Sierra Nevada, 385,922 acres from 2000 to 2019 and 909,827 acres from 2020 to 2024, in Central California, 26,363 acres from 2000 to 2019 and 21,293 acres from 2020 to 2024, and in Southern California, 45,939 acres from 2000 to 2019 and 27,754 acres from 2020 to 2024. The spatial data used to produce this figure are available for download at https://reforestationtoolshed.com/data/.

Future Wildfire-Driven Reforestation Needs, 2025 – 2034

Estimates of existing wildfire-driven reforestation needs were used as inputs to a climate-based projection of future wildfire-driven reforestation needs. This projection suggests a 10-year average rate of 168,856 ac/yr - 217,391 ac/yr of reforestation needs between 2025 and 2034, for a total of 1,688,565 – 2,173,909 acres, as shown in Figure 6. Based on a 10-year historical average from 2015 – 2024 of 191,974 ac/yr, this projected 10-year average is 90% of the historical average on the low end (when future climatic water deficit (CWD) projections are constrained to within two standard deviations of the historical mean), up to 110% of the historical average on the high end (when future CWD is not constrained). 2025 is treated as a future projection because, as of mid-2026, data for this year are not yet complete enough to include in our historical analysis.

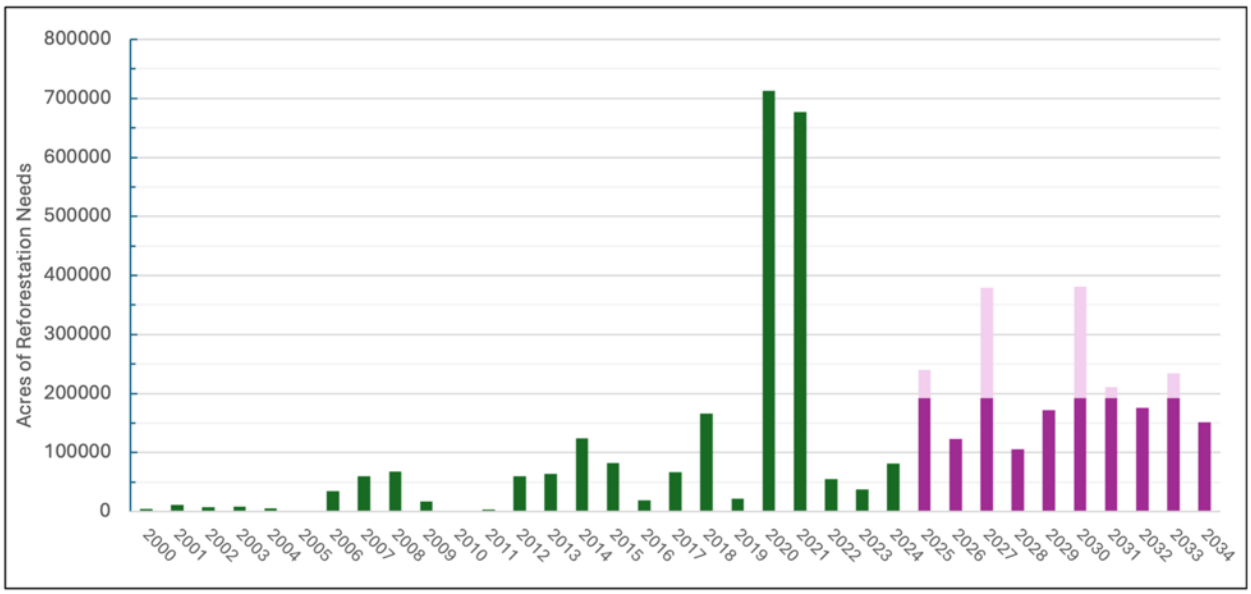


Figure 6. Estimated wildfire-driven reforestation needs, 2000 – 2034
Dark green represents the total acres of wildfire-driven reforestation needs from 2000 to 2024. Pink indicates future projections from 2025 to 2034 (projected 10-year average ~169k – 217k ac/yr, totaling 1.7-2.2 million acres). Dark pink bars are reforestation need projections resulting from future climate projections, using the indicator of climatic water deficit (CWD), where future CWD has been constrained to within two standard deviations of the historical mean CWD. Light pink bars are the additional projected reforestation needs when future CWD projections are not constrained based on the historical mean. Where ranges are presented, the lower value is the reforestation need result when CWD projections are constrained to within two standard deviations of the historical mean (a more conservative estimate), and the upper value results from the unconstrained projection of CWD (a less conservative estimate). Single values are reported when CWD projections were within two standard deviations of the mean without constraint. Future projections are based on the historical relationships between CWD, total forest area burned, and reforestation need since 2000, and do not account for any current or future changes to land management priorities or protocols. Projections for 2025 likely exceed actual needs.

Like all modeling outputs, these future projections are uncertain. Previous studies have reported strong correlations ($R^2 \approx 0.8$) between CWD z-score and the logarithm of annual burned area when aggregated at the scale of the Western U.S. (Abatzoglou et al., 2021). Yet we find substantially lower explanatory power ($R^2 \approx 0.3$) in our analysis evaluating the same relationship when downscaled to just include California. We expect a lower explanatory power when downscaling to California; Western U.S. region-wide analyses benefit from a larger dataset, and California has high interannual and regional hydroclimatic variability. We also used a shorter and more recent period (2000–2024) than Abatzoglou et al. used (1984–2020); a longer period increases sample size and captures a broader range of fire–climate variability. Despite lower explanatory power, we present these modeling results because the relationship between climatic conditions and wildfire is meaningful in California and appropriate for informing long-term reforestation planning scenarios. We also note that our analysis does not account for current and future management actions, which may change the trajectory of future high-severity wildfire behavior and subsequent reforestation needs.

Whereas our climate projections based on a moderate near-term climate change scenario suggest that reforestation needs over the next 10 years may be approximately 90-110% of the current 10-year average, the projections by Delyser et al. (2025) suggest the possibility for a sustained level of need that is 150% of the current 10-year average. Specifically, Delyser et al. estimate 286,485 acres per year of wildfire-driven reforestation needs between 2022 and 2071, based on projected high-severity wildfire levels of 349,373 ac/yr and an estimated 82% natural regeneration failure rate, based on analysis of data from Davis et al. (2023). Whereas Delyser et al.(2025) make climate-based high-severity wildfire projections to 2071 and utilize RCP 8.5, a high emissions scenario, our analysis utilizes the SSP2-4.5, a more moderate emissions climate change scenario to project to 2034. Given this difference in scenario selection, it is possible that our results underestimate potential future reforestation needs. The near-term nature of our projections (mid-2030s) informed our scenario selection.

2. STATEWIDE REFORESTATION ACCOMPLISHMENTS

Background

Reforestation is part of a broad suite of post-wildfire restoration activities to ensure public safety, protect ecosystem services including water supply and recreational assets, and promote landscape health and recovery. Effective post-wildfire reforestation necessitates multiple treatment types and entries conducted sequentially over the same burned area—one acre of successfully reforested land may require 2-5 "activity acres" of reforestation treatment activities over several years within the same "footprint acre" of burned forest. These treatments can include salvage logging, removal of remnant fuels and hazard trees, management of competing vegetation, which may include the use of herbicides, and tree planting or seeding. Follow-up post-planting maintenance activities include vegetation treatments like competing shrub removal, seedling interplanting, or even the introduction of prescribed fire in young stands to promote resilience.

We estimate the area that has been recently reforested in California exclusively using data from the Wildfire and Landscape Resiliency Interagency Tracking System (ITS). Multiple agencies and organizations work in reforestation in California, and gaps exist in these data. Acknowledging that reforestation is a multi-year process, we use complete annual tree planting acres reported to ITS that are classified with reforestation as the primary activity objective to estimate the annual footprint of reforestation accomplishments across California. According to system documentation, reforestation tracked in ITS does not include tree planting associated with timber harvest, so we assume all reforestation data in ITS can be attributed to addressing wildfire-driven reforestation needs. We assume that tree planting acres do not overlap in a single year, and that tree planting occurs when site preparation activities (e.g., removal of remnant fuels and management of competing vegetation) are complete. We report ownership-based accomplishments in terms of the ownership of land where treatments occurred, not the implementing group. To maintain consistency with the periods used to estimate reforestation needs, we tabulate reforestation accomplishment data beginning in 2020, acknowledging that only federal data are available in ITS for years before 2021. While these data allow us to estimate how much area has been reforested in recent years, they do not indicate the success rate or long-term outcomes of reforestation treatments.

Results

We estimate that 254,272 acres of severely burned forest have been replanted since 2020 as part of multi-year reforestation processes, as detailed in Tables 1 and 2. Based on ITS documentation, we assume all reported acres are related to wildfire-driven needs, but data misattribution may be possible. As shown in Figure 7, private industrial lands had the largest extent of reforestation treatments, an estimated 162,146 acres, or 64% of the estimated statewide treatment footprint since 2020. 78,306 acres of federal land have been replanted since 2020, 31% of the statewide footprint. We estimate that 10,413 acres of private non-industrial lands, 3,033 acres of state lands, and a combined total of approximately 375 acres of Tribal, local, and NGO lands have been replanted since 2020. There may be gaps in the ITS data, particularly for reforestation on private

non-industrial lands, so these results may be underestimates. We assume that while some treatments are conducted in wilderness areas, they are statistically negligible. As such, we do not attribute any of the federal reforestation data to wilderness areas. Because the ITS dataset became more complete in 2021, we use the average accomplishment rate from 2021 to 2024, which is 61,827 acres per year, as the business-as-usual accomplishment rate for future estimates of capacity growth and gap size. We also use an average value because there is interannual variability in the data due to a range of factors (e.g., weather, permitting, workforce, changes in organizational activity reporting) that may or may not indicate underlying capacity growth or contraction. Between 2021 and 2024, the year with the lowest reported accomplishment to ITS was 2021 (52,576 acres), and 2024 had the highest reported accomplishment (78,340 acres).

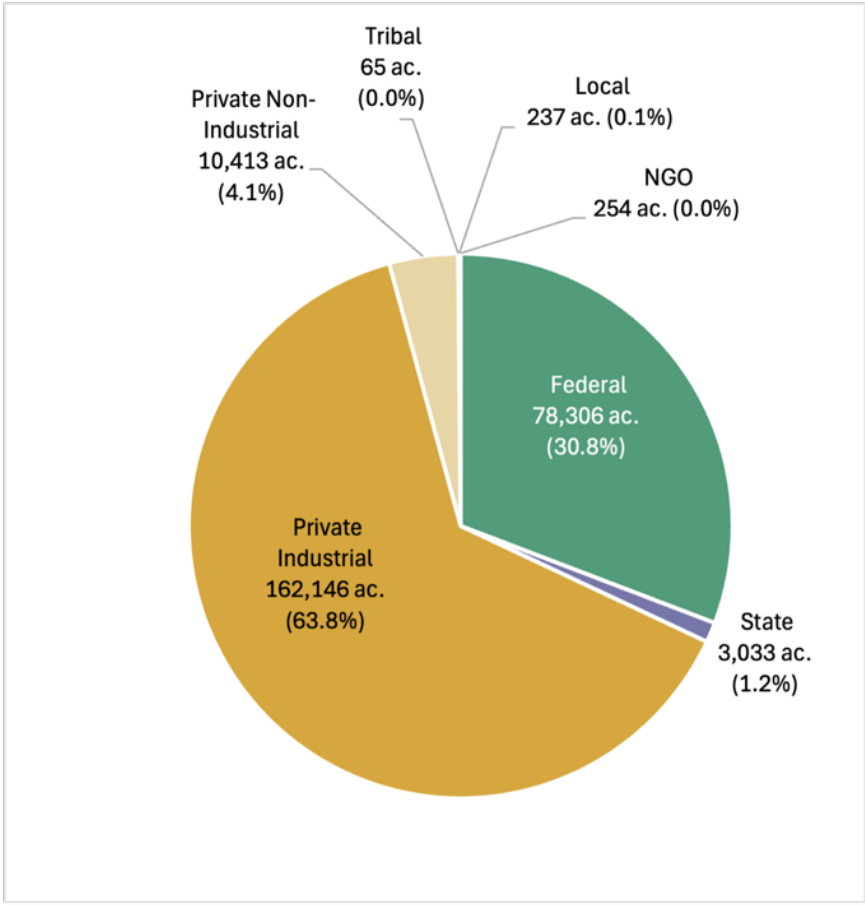


Figure 7. Reforestation accomplishments by ownership, 2020 – 2024
These accomplishment figures are estimated using data from the Wildfire Interagency Tracking System, 2020 – 2024, and total 254,272 acres. Note that accomplishments are attributed based on the treatment location and may not reflect the actual funding or implementing agencies.

3. CALIFORNIA'S REFORESTATION GAP

California's reforestation gap is the difference between the area that needs to be reforested and the area that has been reforested. Tracking this gap is important because when severely burned areas are not reforested within the first several years, they may experience repeat high-severity wildfire and/or undergo permanent type conversion to non-forested vegetation cover, such as shrub-or grass-dominated cover (Coppoletta et al., 2016; Guiterman et al., 2022). While some amount of landscape heterogeneity can be ecologically beneficial, large-scale forest cover loss compromises ecosystem services like landscape carbon storage, wildlife habitat, timber provisioning, and recreation.

We compared the estimates of reforestation needs with annual treatment data from ITS to estimate the reforestation gap size across ownerships and regions since 2020. This gap accounting method assumes that all ITS-reported reforestation data can be counted toward meeting wildfire-driven reforestation needs, which is consistent with ITS system documentation which states that tree planting associated with timber harvest operations is not tracked in the system. As shown in Table 2, part C, we estimate that 84% of the state's wildfire-driven reforestation needs since 2020 have not been addressed, for a total gap size of 1.3 million acres. By ownership, the largest portion of the untreated need is on federal lands and in designated wilderness, as shown in Figure 8. The smallest gap by ownership is on private industrial lands, where, since 2020, needs have only slightly outpaced treatments. This analysis does not include regional gap estimates because a substantial portion of the accomplishment data lacks spatial information.

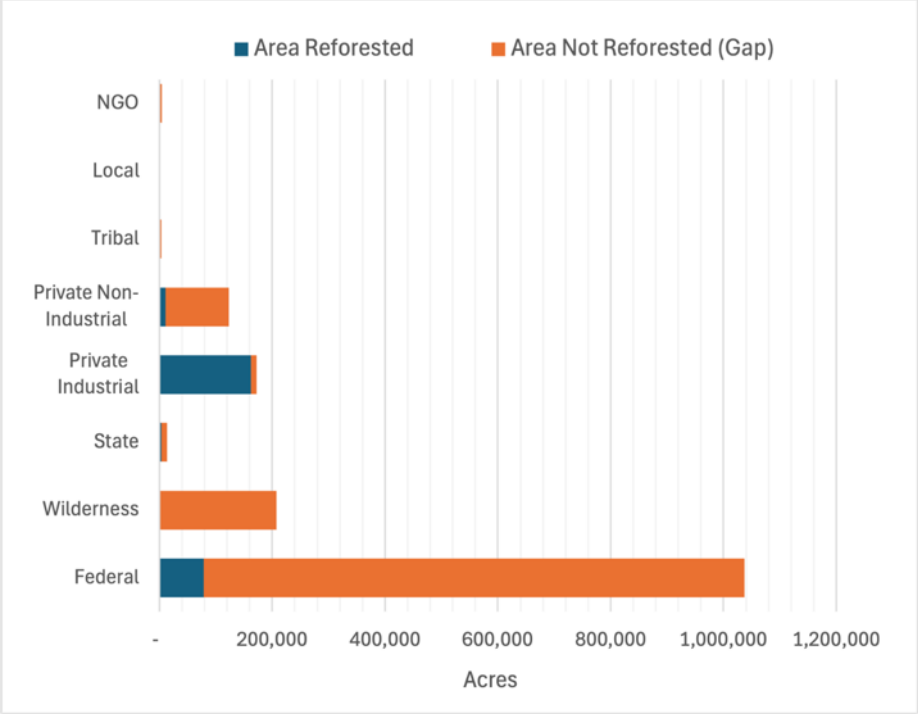


Figure 8. California's post-wildfire reforestation gap by ownership, 2020 - 2024
The bar size indicates the total area requiring reforestation due to wildfires from 2020 to 2024, by ownership. Blue is the portion of the total that has been reforested, and orange is the portion that has not been reforested.

While this analysis offers a comprehensive look at wildfire-driven reforestation needs across the state (Box 1), it excludes forest types that are known to resprout following high-severity wildfire, including aspen, redwood forests, and oak woodlands. We do not count post-wildfire acres of these vegetation types toward reforestation need totals because they do not necessarily require the full suite of reforestation treatments to persist in the way that many other California conifer dominated systems do. However, these forest types may still benefit from or even require other post-wildfire treatments like salvage logging or vegetation management to grow into healthy, wildfire-resilient forests. The reforestation need estimates presented are somewhat sensitive to the maximum distance that we assume conifer seeds in California can travel, on average, from a living seed source to reseed a burned area. Increasing the assumed maximum seed dispersal distance from 35m (~115 ft) to 60m (~197 ft) while holding other criteria constant reduces estimated reforestation needs statewide by 9% in the 2000 to 2019 period, 6% for 2020 to 2024, and 7% for 2000 to 2024. Finally, while there are >1.3 million acres of reforestation needs from 2020 to 2024 that are currently unaddressed, the practical feasibility of reforesting these areas varies widely, a consideration discussed in a subsequent section.

Box 1 - California's Reforestation Gap Key Takeaways

- Average annual wildfire-driven reforestation needs grew **600% between 2000 - 2019 and 2020 – 2024** due to an increase in high-severity wildfires and extreme fire years in 2020 and 2021.
- By ownership, most unmet need is on **federal lands; only ~8%** of severely burned non-wilderness federal forestlands have been reforested since 2020.

4. SCALING AND PRIORITIZING REFORESTATION ACTIVITY

Background

Based on our analyses, an estimated 826,643 acres of California forest burned at high severity between 2000 and 2019 and are unlikely to regenerate naturally. Because there are insufficient treatment data in the ITS before 2020, the fraction of this area that has been reforested to date is unknown. Of the1.5 million forest acres that burned between 2020 and 2024 that are unlikely to regenerate naturally, approximately 1.3 million acres have not been reforested. The current baseline of conifer extent in California used in our analyses may be somewhat higher than the extent of forest cover prior to Euro-American settlement due to widespread fire exclusion and suppression that supported conifer encroachment into non-forested areas . While low-to-moderate and small patches of high severity fire can have restorative effects in California's forests, including by creating landscape heterogeneity, there are ecological and socio-economic costs when large extents of forests are lost to high severity wildfire and subsequent natural regeneration failure. A recent report by American Forests and CAL FIRE indicates that under business-as-usual conditions in a high emissions climate scenario, nearly half of California's forests may be lost to wildfire and climate impacts by 2071 under a high emissions (RCP 8.5) scenario (Delyser et al., 2025). Sustaining healthy future forest cover in California depends on both pre-fire efforts to restore forest health and expanded reforestation efforts when damaging wildfire occurs. This section discusses the potential future of California's reforestation gap in terms of potential near-term (2026-2031) reforestation capacity and accomplishments as well as how reforestation treatments could be prioritized across post-fire landscapes based on potential benefit.

Considerations for Closing the Gap

Federal and State Policies & Targets

The federal government and the State of California have both recognized the importance of post-wildfire reforestation (Administration of Governor Gavin Newsom, 2024; Repairing Existing Public Land by Adding Necessary Trees (REPLANT) Act, 2021). The majority of recent reforestation needs are on public lands (~80%), and forest management on most private lands is governed by state policies. The State of California's 2024 Nature-Based Solutions Climate Targets, designed to deliver resilient ecosystems and durable carbon stocks and set the pathway to meet state carbon neutrality and climate resilience goals includes specific targets for post-wildfire reforestation. State targets include actively replanting and restoring forested areas burned by high-severity wildfire at a rate of 280,000 acres per year by 2030, increasing to 420,000 acres per year by 2038. And, depending on future reforestation needs, ramp down to 280,000 acres per year by 2045, all for a total of 6.5 million acres of treatment by 2045.

Federal legislation and strategies also speak to the need to increase reforestation accomplishments. The 2021 REPLANT Act directs the USDA Forest Service to address the backlog of reforestation needs on National Forest System lands by 2031 and removes a prior cap on annual reforestation funding. In 2023, in response to Executive Order 14072

that called for agency-specific reforestation targets, the U.S. Departments of the Interior and Agriculture jointly released public land reforestation targets for 2030 that total 2.3 million acres, with specific objectives for multiple individual agencies, including 1.8 million acres of reforestation on National Forest System lands. Active forest management is a current Forest Service priority that includes accelerating reforestation to restore burned areas.

Scaling reforestation commensurate to need and achieving government targets requires broad-scale cooperation and incentive alignment, as post-wildfire reforestation is not always compulsory. On state-owned lands, the California Public Resources Code § 4631 establishes the expectation that cutover timberlands should be reforested but does not mandate post-wildfire reforestation. On private lands, reforestation following wildfire is not compulsory; however, replanting is required following timber harvest, including when timber is harvested as part of post-wildfire salvage logging, per the 1973 California Forest Practice Act and associated California Forest Practice Rules. On the federal side, the 1976 National Forest Management Act established the expectation for reforestation on National Forest System lands by requiring that appropriate forest cover be maintained within the System. An amendment to the Forest and Rangeland Renewable Resources Planning Act in 2021 expanded the reforestation requirement to include unplanned disturbances like those from wildfire. Despite these regulatory underpinnings encouraging reforestation, activity levels are not meeting current needs.

Climate Change

A signature of changed climatic conditions, including warming, drying conditions, and shifting precipitation patterns, is present across much of the state's forested ecosystems—the same ecosystems where high-severity wildfire is driving reforestation needs (White et al. 2023, Ostoja et al. 2023). These warmer and drier conditions affect the survival of young trees. Even with substantial investments to increase reforestation capacity and conduct widespread forest health treatments to moderate fire severity, the reforestation gap is likely to remain large in future years as climate change intensifies wildfire behavior and impacts (Abatzoglou et al., 2021). Evidence that dense, homogeneous forest structures increase the risk of climate-related stress and high-severity wildfire (Levine et al., 2025), along with observed climate impacts in forests, is prompting the development and adoption of climate-informed reforestation practices. This approach is outlined in a subsequent section and in strategy goal 4.

Supporting Tribal Stewardship

Early, frequent, and meaningful engagement with California Native American tribes is a key aspect of reforestation that supports restoring healthy forest ecosystems and promoting culturally significant plant species while also reducing California's reforestation gap. Consulting with California Native American tribes prior to reforestation activities is essential to ensure that Tribal cultural resources are identified and protected in post-fire landscapes. Additionally, tribes have Traditional Ecological Knowledge (TEK) on unique local factors and conditions that can inform successful reforestation efforts. Tribes are well-positioned to lead or consult on efforts to restore resilience in post-fire landscapes through practices like reintroduction of ecologically and culturally important species, such as fire-resilient hardwoods, in severely burned forests (see species composition row, Table 5). Addressing post-wildfire reforestation

needs provides an opportunity to expand Tribal stewardship on tribes' ancestral homelands, consistent with federal and state priorities and Tribal stewardship objectives in the 2026 Draft Wildfire and Landscape Resilience Action Plan and CNRA's Tribal Consultation Policy. The story box below provides an example of consultation and active co-stewardship between the Berry Creek Rancheria of Maidu Indians of California and the Plumas National Forest.

Tribal Stewardship Story Box: From Consultation to Co-Stewardship

In the years following the North Complex Fire (2020), post-fire recovery on the Feather River Ranger District on the Plumas National Forest has highlighted both the scale of California's reforestation challenge and the need to rethink how to restore forests for future resilience, rather than just replacing what was lost.

Collaboration between the USDA Forest Service and the Berry Creek Rancheria of Maidu Indians of California offers an encouraging example of shared stewardship in action, where cultural knowledge, ecological restoration, and prescribed fire are being woven together to cultivate a healthy, diverse forest from the understory up through a future canopy. A relationship that began as a post-fire consultation between the Forest and the Tribe has evolved into a working partnership.

Today, Tribal crews are managing vegetation in post-fire sites and cultural and Tribal members advise Forest Service staff on the preservation of culturally significant plants. The Berry Creek Rancheria of Maidu Indians has submitted a plan proposal for ancestral lands within the Plumas National Forest through the Tribal Forest Protection Act (TPFA). The TFPA is a pathway for mutually beneficial, cross-boundary work within the National Forest System and allows federally recognized Tribes to propose projects to be conducted on Forest Service land to reduce threats to adjacent Tribal lands, trust resources, and values.

A shared vision of success according to project and land managers is emerging as the work continues: that Maidu people can once again gather food, fibers, and medicine on these lands, and that stewards can safely return prescribed fire to the landscape.



Project partners from the Berry Creek Rancheria of Maidu Indians of California and USDA Forest Service staff discuss co-stewardship perspectives during the "Reforestation in a Burning Landscape" field tour. July 23, 2026. Plumas National Forest.

Reforestation Costs

The reforestation process involves collecting seeds, nursery propagation and management, project planning, site preparation, including removal of excess fuels, planting, vegetation management, monitoring, and maintenance treatments, which may include the use of beneficial fire. Each step contributes to reforestation outcomes, which can take a decade or more to be fully realized, and committing to the full process is critical for long-term success. The costs associated with this multi-step process are difficult to estimate and vary greatly based on multiple factors, including land ownership, forest type, time since wildfire impact, site location and access, labor availability, and the need for post-planting management, which depends on site productivity.

The estimated per-acre reforestation costs presented in Table 3 were derived by combining the 2025 cap rates, the maximum per-acre reimbursement limit for specific treatments, for a suite of reforestation activities included in the California Forest Improvement Program (CFIP). These estimates do not include certain additional costs that may be incurred in the reforestation process, including permitting, project planning, cone scouting, collection and processing, precommercial thinning, and archeological assessments, which together could add multiple thousands of dollars per acre. Importantly, these rates also do not include any costs associated with removing trees from a burned site, commonly referred to as hazard tree removal if public safety is a concern or salvage logging if value can be recouped from harvest. Post-wildfire tree removal may require additional spending, in some cases, multiple thousands of dollars per acre, or may yield net profits if the harvested material can be sold, which depends on site location and market conditions. The combinations used here are for coarse-scale estimates of all-lands reforestation costs statewide and do not necessarily reflect treatment combinations that are refundable by CFIP in all cases.

Table 3. Estimated per-acre costs of post-wildfire reforestation, based on California Forest Improvement Program rates, 2025

Low to Low-Medium Reforestation Costs and Project Attributes			
Est. Per-Acre Costs		Source & Assumptions	General Project Attributes that Influence Cost
Low	~$1,850	California Forest Improvement Program (CFIP) 2025 Cap Rate, incl. "light" tier of: chemical site prep, planting, chemical release, and follow-up mech. veg mgmt.	Project attributes that may reduce reforestation costs: • **Easy Access**: Flat or slightly sloped ground, close to established road infrastructure. Shorter transport distances for removed biomass. • **Shorter Time Since Disturbance**: Less growth of competing vegetation, lower tree hazards. • **Lower Seed and Seedling Costs**: Appropriate seeds or seedlings already available and plentiful.
Low-Medium	~$2,769	California Forest Improvement Program (CFIP) 2025 Cap Rate, incl. "light" tier of chemical and mech. site prep, planting, mech. release, and follow-up mech. veg mgmt.	
Medium-High to High Reforestation Costs and Project Attributes			
Per-Acre Costs		Source & Assumptions	General Project Attributes that Influence Cost
Medium-High	~$3,808	California Forest Improvement Program (CFIP) 2025 Cap Rate, incl. "moderate" tier of: chemical and mech. site prep, planting, chemical release, and follow-up mech. veg mgmt.	Project attributes that may increase reforestation costs: • **Challenging Access**: Steep or difficult-to-access ground, far from established roads. Longer transport distances for removed biomass. • **More Time Since Disturbance**: Growth of competing vegetation, elevated tree hazards. • **Higher Seed and Seedling Costs**: Appropriate seeds or seedlings scarce or unavailable, requiring scouting and cone collecting.
High	~$6,426+	California Forest Improvement Program (CFIP) 2025 Cap Rate, incl. "heavy" tier of: chemical and mech. site prep, planting, chemical and mech. release, and follow-up mech.	

Based on 2025 reimbursement values from the California Forest Improvement Program (CFIP), the full suite of reforestation activities; from seed collection and site preparation to planting and post-planting management can cost as little as $1,850 per acre in some areas and exceed $6,400 per acre in others. However, it should be noted that the salvage and biomass removal stages of site preparation may be pursued in certain post-wildfire landscapes regardless of whether reforestation is planned, especially in areas that receive immediate attention post-wildfire (e.g., roadways and in and near communities). Where buyers and processing infrastructure are available, the sale of salvage timber harvested during site preparation can partially offset reforestation costs.

Operability Limitations

Even if unlimited resources were available, not every acre of reforestation need in California can be treated due to a suite of constraints. These constraints may be administrative (i.e., sensitive habitat and riparian areas), legal (i.e., wilderness), and operational (i.e, equipment access) in nature (North et al., 2015). These constraints are most prominent in the site preparation and post-planting management phases of reforestation, both of which may require large, mechanized equipment. The need to use machinery can render certain parts of the landscape untreatable, including in designated wilderness areas, sensitive wildlife habitats, USDA Forest Service Research Natural Areas, and along riparian corridors. Further, even where heavy equipment use is

permissible, access can be physically limited by steep slopes and a lack of road infrastructure, particularly in Forest Service Inventoried Roadless Areas. North et al. (2015) report that in the National Forests of the Sierra Nevada region, legal, operational, and administrative constraints exclude much of the landscape from mechanical treatment, leaving what they estimate as 43.8% of the productive forest lands mechanically treatable. However, the treatable portion of forestlands varies greatly across different regions of California. Looking at California landscapes identified by the Forest Service as strategically important to treat for wildfire resilience, Woolsey et al. (2024) estimate the mechanically treatable portion ranges from 6% to 33% under status quo operating conditions. However, when Woolsey et al. (2024) apply different operational assumptions that reflect increased investment to overcome physical constraints and reduced administrative hurdles in certain areas, the estimated treatable portion is higher.

Scenarios for Scaling Up Reforestation in California

Scenario Overview

In this section we provide a means to consider and contextualize potential scenarios for scaling up California's statewide reforestation capacity and accomplishments over the next five years (2026–2031). Using the reforestation needs quantified in this analysis, we examine how different levels of investment and implementation could reduce the state's reforestation backlog, assess progress toward restoring fire- and disturbance-affected landscapes, and estimate the remaining reforestation gap under each scenario. We quantified the potential trajectory of four scenarios based on different compound annual growth rates (CAGR) for reforestation accomplishment: 5%, 20%, 32.7%, and 35.3% (presented hereafter as 33% and 35%). All scenarios start from a shared baseline accomplishment rate estimate for 2025 that is equivalent to the annual average accomplishment realized in California between 2021 and 2024, as reported in part 2. For these scenarios, the assumed starting point for accomplishment rate is the average of the 2021 to 2024 period because, due to a combination of factors including weather, permitting, workforce availability, and reporting, the reforestation accomplishment reported to the ITS varies annually and may or may not reflect underlying capacity changes on an annual basis.

The 33% and 35% CAGR scenarios are driven by specific accomplishment objectives to substantially scale up reforestation, whereas the 5% and 20% CAGR scenarios show the outcomes of applying slightly lower growth rates and are not driven by any specific objective. 5% CAGR represents a modest growth rate based largely on status quo efforts to scale. 20% CAGR would reflect rapid growth that would require substantial new investments in reforestation and serves as a midpoint between the modest 5% and very rapid 33% and 35% scenarios. The 33% CAGR scenario is based on the hypothetical objective to realize no net change of the reforestation gap between 2024 and 2031. The 35% CAGR scenario is based on the objective to realize the 2030 accomplishment rate included in the State's nature-based solution (NBS) targets for post-wildfire reforestation, 280,000 ac/yr. The State NBS targets also estimate that reforestation rates will need to continue to be scaled up to reach 420,000 ac/yr by 2038 and then ramp down to 280,000 ac/yr by 2045. We note that those time points are beyond the temporal range of this document. We exclusively consider State of California targets in

this section because the reforestation targets released by the Departments of the Interior and Agriculture in 2022 neither specify the regional distribution of these targets nor the portion of the targeted acres that are intended to address post-wildfire reforestation needs. The key assumptions underlying the scenarios and their numerical details are presented in Table 4.

Table 4. Capacity Growth Scenarios for Reforestation in California

In tabulating scenarios, an assumed constant annual rate of new wildfire-driven reforestation needs was applied to each year (2025 – 2031) and across all scenarios. The annual value, 168,856 acres/year, is the low-end 10-year average climate-based projection described in this document. We assume that 100% of treatments from 2025 through 2031 are applied to wildfire-driven needs that have occurred since 2020. We also assume that the 2025 accomplishment rate is equivalent to the annual average rate from 2021 to 2024, as 2025 accomplishment data are not yet available. 2026 values and annual values thereafter are determined by applying the scenario compound annual growth rate to the previous year's rate, except for the 2031 value for the NBS Targets scenario, whose value (297,500 ac/yr) aligns with the linear scale-up of the 2030 target amount per the NBS Targets Methodology Document.

		Modest Growth	Rapid Growth	No Net Change in Gap	Achieve NBS Targets
Scenario Compound Annual Growth Rate (2026 - 2031)		5%	20%	33%	35%
Scenario Annual Reforestation Level (ac/yr)	2025	61,828	61,828	61,828	61,828
	2026	64,919	74,193	82,063	83,633
	2027	68,165	89,032	108,921	113,129
	2028	71,573	106,838	144,569	153,027
	2029	75,152	128,206	191,885	206,996
	2030	78,909	153,847	254,686	280,000
	2031	82,855	184,616	338,041	297,500
Scenario Summaries (2020 – 2031)					
Resultant Projected Reforestation Gap Size in 2031 (ac.)		1,987,790	1,692,632	1,309,199	1,295,078
Total Amount Treated since 2020 (ac.)		503,401	798,559	1,181,992	1,196,112

Scenario Results

The scenarios in Table 4 illustrate how different capacity scaling rates for statewide reforestation accomplishment could play out over the next five years in terms of the resultant projected reforestation gap. Results suggest the Modest Growth (5% CAGR) scenario would likely result in the largest unmet need (1.99 million ac.) by 2031 and the Achieve NBS Target (35% CAGR) scenario would result in the smallest gap (1.30 million ac.) by 2031. The projected gap sizes are highly dependent on the assumed rate of new wildfire-driven reforestation needs. This assumes that new reforestation needs accumulate at a rate of approximately 169,000 acres/yr, the low-end 10-year average projection for 2025 to 2034 shown as dark pink bars in Figure 6. For reference, the annual accumulation rate between 2000 and 2019 was 41,332 ac/yr and rose to 312,694 ac/yr between 2020 and 2024. In the American Forests and CAL FIRE report, the modeled combination-type portfolios that mitigate forest losses and forest-related carbon emissions include scaling post-wildfire reforestation to nearly 10 million acres between 2022 and 2071, with a peak rate of 172,000 ac/yr of reforestation from 2022 to 2032

(Delyser et al., 2025). Achieving this annual accomplishment rate by 2031 would require a compound annual growth rate of 18.6% from 2026 to 2031, which is close to the Rapid Growth (20% CAGR) scenario. All scenarios point to the importance of scaling up, each of which have unique implications and considerations by ownership group. It is important to note that scaling up reforestation planting efforts must be accompanied by a long-term commitment to the post planting maintenance required to restore resilient forests.

Scaling Considerations Across Ownerships

Reducing the statewide reforestation gap would require each ownership group to scale its efforts differently. Currently, about 32% of the reforestation conducted statewide occurs on public lands, and 68% occurs on private lands. To reduce the reforestation gap, there is a greater need to scale up reforestation on public lands than on private lands, primarily due to the vastly larger scale of unmet needs on federal lands. Notably, reforestation assistance flows in both directions between the public and private sectors. Some private land reforestation is funded through public programs like the California Forest Improvement Program (CFIP) and Emergency Forest Restoration Teams (EFRTs), and non-governmental private partners may assist with public lands reforestation through partnership or stewardship agreements. We can assume a reasonable, per-acre cost of $3,000 to conduct initial reforestation treatments on all lands. This value is derived from the CFIP maximum reimbursement (cap) rates offered by CAL FIRE for a full suite of light to moderate reforestation treatments, with the high end of reimbursable treatments at approximately $6,400 (see Table 3). These costs do not account for salvage timber harvest. Where infrastructure and market demand exist, salvage timber sales from both public and private lands can offset reforestation costs. The following sections outline considerations for scaling up reforestation on private lands, through Tribal stewardship, and in consideration of current and anticipated climate effects.

Private Lands Scaling Considerations

Total reforestation needs on private lands in California since 2020 are approximately 296,000 acres, 18.9% of the statewide total. Private industrial lands, which comprise 58% of private lands reforestation needs, have the smallest ownership-based reforestation gap (we estimate 94% of wildfire-driven reforestation needs have been treated on private industrial lands, compared to a statewide average of 16%). The reforestation gap is substantial on private non-industrial forestlands, which comprise 42% of private land reforestation needs. Only 8% of reforestation needs on private non-industrial lands have been addressed since 2020 (112,708 acres untreated from 2020 – 2024).

Scaling reforestation statewide to preserve forest cover will require scaling up private land reforestation, particularly on private non-industrial ownerships where the gap is large. Even though post-wildfire reforestation is largely voluntary on private lands, private industrial landowners typically have the capacity and economic incentives to reforest quickly. They have also received some public reforestation assistance after large incidents like the 2021 Dixie Fire. Non-industrial private landowners may be less likely than private companies to reforest quickly and may need extra support from public programs like the Emergency Forest Restoration Teams (EFRTs). EFRTs work through local agencies like Resource Conservation Districts and counties to rapidly

deploy post-wildfire disaster relief funds, often under emergency authorizations, to execute fuels reduction and reforestation projects with small, private non-industrial forest landowners across California.

Reforestation on Tribal Lands

Addressing reforestation on Tribal lands can help close the reforestation gap, which is estimated as 3,279 acres for 2020 - 2024. Programs like CAL FIRE's Tribal Wildfire Resilience Grants are available to tribes to fund planning and implementation projects like reforestation. Consulting with California Native American tribes prior to active reforestation is an important component of reforestation efforts on both Tribally and non-Tribally managed lands to ensure Tribal cultural resources are protected. These consultations are part of reforestation projects when they are subject to California Environmental Quality Act (CEQA) or National Environmental Protection Act (NEPA) environmental reviews. Additionally, co-management agreements such as memoranda of understanding (MOUs) and Good Neighbor Agreements with state and federal agencies provide opportunities for tribes to lead or partner on reforestation projects on tribes' ancestral lands.

Adapting to Climate Conditions at Scale

Because forests consist of long-lived species, successful reforestation scaling requires considering tomorrow's growing conditions when planning to scale up today's reforestation efforts. Reestablishing forest cover when conditions are warm and dry and precipitation is variable is difficult. Reforestation projects may fail due to seedling or young tree die-off, plantation reburns, or a lack of follow-up maintenance treatments. The density and arrangement of forests affect their long-term survival; Levine et al. (2025) determined that across all ownerships in the Dixie Fire, tree stem density and forest homogeneity were the most important predictors of high-severity wildfire.

Reforestation projects must account for current and future eco-climatic conditions to produce healthy forests that are resilient to future wildfire impacts. Ecologically-informed reforestation involves integrating climate considerations into the planning, implementation, and follow-up management of reforestation projects. Ecologically-informed planning places attention on reforestation efforts on areas where forests are likely to persist under current and future climate conditions (North et al. 2019, Meyer et al. 2021; Hill et al. 2023). In some cases, adapting to climate change may require accepting replacement species or forest types for a given location when historical types can no longer be expected to persist, per the Resist-Accept-Direct (RAD) climate adaptation framework. Implementing climate-informed practices generally incurs the same costs as conventional practices, though work crews may initially require extra time to learn new techniques.

In landscape scale reforestation efforts, a climate-informed approach may entail starting by identifying where on the landscape certain forest types are expected to persist under future conditions. At the parcel scale, climate-informed approaches to reforesting can include incorporating more drought-resistant species and climate-adapted seeds into planting mixes, planting at lower densities and with variable spacing (Swanston et al. 2020; North et al. 2019). Post-planting management to promote climate resilience may involve vegetation control, stand thinning,

interplanting, and the use of beneficial fire to moderate the impacts of potential wildfire reburns. A suite of twelve forest-type-specific reforestation booklets with guidance on promoting resilience to climate effects and extreme weather in California is available on the California Reforestation Toolshed website; general principles from these booklets are summarized in Table 5.

Table 5. Reforestation practices to promote climate resilience in California

Site Prep	• Managing **remnant fuels**, **competing vegetation**, and **soil moisture** is critical to mitigate drought and risk of reburning.
Species Composition	• Adjust planting proportions to **favor more drought-resistant species**, including hardwoods, generally by 20 -30%, and especially in low-productivity sites. • Increase genetic diversity by using a mix of local and **climate-adapted seeds.**
Planting	• Buffer seedlings from drought and exposure by **planting in microsites.** • Avoid overly dense plantations; initial **planting densities** should reflect both the capacity to manage sites in the future and expected survival rates. • Create wildfire resilience in mature stands by **planting lower densities and variable spacing** (ICO), except for in Southern Montane Forests.
Post-Planting	• Successful reforestation doesn't end at planting, budget and plan for **maintenance** and **monitoring**. • Conduct ongoing **vegetation control**, consider introducing **beneficial fire** where and when appropriate.

Benefits of Scaling Up Reforestation

Ecosystem Services

Scaling up reforestation and restoring healthy forests offers benefits to California's social and ecological systems that can extend to future generations. The watersheds of the Sierra Nevada and Southern Cascade ranges source about 60 percent of California's water supplies on average (State Water Plan, 2023). Reestablishing healthy forest cover, which regulates snowpack accumulation and melt, can help extend water supplies in snow-fed systems longer into the warm, dry parts of the year. Healthy forest ecosystems are an asset to both people and wildlife. Post-fire reforestation can benefit California's recreational economy by making wildfire-impacted trail systems and ski areas safer and more desirable for future users. Reestablishing healthy forests after wildfire can also help sustain rural economies, where timber and natural resource management jobs are economically significant.

Carbon Benefits

Reforestation can contribute to the development and maintenance of long-term forest carbon stocks and realization of the state's climate goals. Many of California's forests, particularly those burning at high severity, currently store unnaturally high levels of carbon due to high historical stocking levels and fire exclusion. These forests are also often highly vulnerable to wildfire and climate-driven mortality; preventing large, destructive wildfires is critical for many reasons, including reducing carbon emissions. When severe wildfires occur, reforestation is a much-needed mitigation to preserve long-term carbon storage potential. Reforesting prevents the conversion of forests to

shrubs and grasses, which have lower per-acre carbon storage capacity, and can speed up the recovery of carbon benefits.

In the first few decades after planting, reforestation can yield 2-3x more aboveground carbon accumulation in biomass compared to natural forest regeneration (Nave et al., 2018). However, given the difficulties of reestablishing forests under warm, dry conditions, planting solely for carbon storage benefits in these contexts may not offer substantial returns (Marsh, Hurteau, and Burney, 2026). Furthermore, replacement stands will likely hold less carbon if restocked at ecologically appropriate (lower) densities compared to recent historical stand densities. Yet, the benefits of reforestation extend well beyond carbon storage, and can also include reducing future wildfire risk.

Wildfire Risk Reduction

The more than one million acres of severely burned forest lands that have not been reforested may have high fuel loads that leave them at risk of high-severity reburn. Removing these remnant fuels, the first step in a reforestation project, reduces their risk of reburning, emitting additional carbon and fine particulate matter (PM2.5). Fuels treatments preceding reforestation also create opportunities to use salvaged wood for high-value purposes, such as timber, or to use woody biomass for energy generation. However, to realize these risk-reducing benefits over the long term, reforestation scale-up efforts must be climate-informed, using appropriate densities, arrangements, and species mixes to create forests resilient to future drought and wildfire disturbances, and be accompanied by sustained management efforts to promote resilience, such as the use of beneficial fire.

Prioritization Tiers to Target Reforestation Effort

Reforestation is one of many wildfire and landscape resilience priorities for land managers to consider when determining how to allocate capacity and funds to protect and restore landscapes and communities. When reforestation is identified as a local or regional priority, limited funding and workforce, regulatory restrictions, and other factors influence where, when, and how land managers reforest following wildfire. Prioritization concentrates available resources in the areas of greatest potential impact and need and provides clear, consistent decision-making support in dynamic situations. We propose using a three-tiered approach to prioritize reforestation treatments, summarized in Table 6. This framework was developed with expert input from CAL FIRE, the USDA Forest Service, American Forests, and the University of California. This tiered framework is meant to assist in the determination of where to apply reforestation resources across a post-fire landscape once reforestation has been determined to be a land management priority.

Table 6. Prioritizing reforestation in California to maximize benefits in 2026 and beyond

Reforestation Priority Tier	Inclusion Criteria
Tier 1: Critical Human Safety and Ecosystem Services	• Opportunities to enhance post-wildfire public safety (e.g. removal of trees that pose safety hazards or would contribute to excessive fuels loading) • Sites most proximate to communities and with time-sensitive needs • Opportunities to protect critical infrastructure and resources (e.g. water supply)
Tier 2: Ecosystem Service Values	• Ecosystem restoration opportunities (e.g. watershed health and habitat) • Opportunities to protect non-safety-critical human values and needs (e.g. recreation) • Areas with high likelihood of long-term success and maintenance, though somewhat less time sensitive than those in tier 1.
Tier 3: Situational Opportunities	• Activities that leverage proximity to other projects or connected landscapes to amplify the benefits of tier 1 and 2 efforts • Areas with high likelihood of long-term success and maintenance

Tier 1: Critical Human Safety and Ecosystem Services

The highest priority reforestation actions are those that can directly benefit critical human needs, and in particular, reforestation activities to enhance post-wildfire public safety, such as salvage logging and hazard tree removal. Reforestation activities to protect critical infrastructure and resources (e.g., water storage and delivery) should also be prioritized in this tier. Reforestation activities in this tier should aim to reduce fire hazard, improve the quality of life, and bolster local economies affected by severe fire. For these reasons, they should be the top priority.

Determination of appropriate project scope, scale, and treatment type in tier 1 should be informed by the fire effects to population centers, built infrastructure, and other resources of interest. In general, tier 1 projects should address the needs and risks that are most time sensitive. Reforestation actions in this tier should concentrate on restoring tree cover, reducing the accumulation of dead fuels, and controlling competing and hazardous vegetation. Project design should consider ways to generate economic activity and enhance local livelihoods. Examples of focal areas for tier 1 efforts include sites in and around the Wildland Urban Interface and priority ingress and egress roadways that may be needed for post-wildfire recovery activities.

Tier 2: Ecosystem Service Values

Reforestation action in the second priority tier can be broadly framed as reforestation motivated by the need for ecosystem restoration, including improvements to watershed health, biodiversity, and habitat quality, and connectivity. Reforestation opportunities that would protect other non-critical human values and needs, such as recreation, may also be considered in priority tier 2. In general, tier 2 projects should address needs and risks that are somewhat less time sensitive than those in tier 1.

Areas within tiers 1 and 2 may be addressable by the same project(s) and on roughly the same timeline. Once tier 1 considerations are used to identify and solidify project

needs, tier 2 considerations can help refine project scope, scale, and treatment type by evaluating fire effects to relevant values. Project design should be informed by factors that influence the success and necessity of future management, including historic fire extent and severity, the likelihood of natural tree regeneration without intervention, and current and anticipated future site productivity. Tier 2 project areas should demonstrate high likelihoods of successful implementation and of continued maintenance. Additionally, tier 2 projects should favor implementation within logical biophysical units, such as watersheds.

Tier 3: Situational Opportunities

The third tier of reforestation priorities includes opportunities to leverage proximity to other projects or connected landscapes to amplify the benefits of tier 1 and 2 efforts. In general, tier 3 reforestation priorities are projects that address the least time-sensitive needs and risks. Defining the project scope, scale, and treatments of tier 3 efforts would be based on existing planning and implementation efforts and determined by considering where expanded project boundaries and activities would produce significant additional social or ecological outcomes.

Areas that do not meet tier 1 or 2 characteristics (i.e., relatively lower social or ecological benefits and values), but that still have a high likelihood for reforestation success, may be treated as tier 3 opportunities. Practically, this could be accomplished by expanding the boundaries of tier 1 or 2 projects, provided that the inclusion of tier 3 areas would likely improve the outcomes of existing project scopes and would not severely impact their feasibility.

This three-tiered framework offers principles to direct the application of limited reforestation resources to maximize potential benefits. The broad principles of addressing urgent human safety and infrastructure needs first, then prioritizing broader ecological benefits and expanding where opportunities allow, can be adapted and applied regionally and locally across California to preserve forests and support community recovery following wildfire. While prioritization can help maximize benefits derived from reforestation efforts, scaling total reforestation accomplishments statewide is foundational to mitigating forest losses and preserving forest ecosystem services (Box 2).

Box 2 – Key Considerations to Close the Gap

- **Some amount of forest loss is likely unavoidable:** Not all reforestation needs are feasible to treat, and many acres may have already undergone substantial type conversion from forest to shru-bland or even grassland.
- **Acting quickly can make the difference:** as time passes after a site burns, the costs and challenges associated with reestablishing healthy forests increase.
- **Management decisions matter:** A report by American Forests and CAL FIRE shows that with a combination of actions, including ~10M reforestation acres over 50 years, and when certain assumptions are applied, projected future forest losses can be reduced substantially.
- **Public – private partnerships are essential:** NGO and private sector partners, including Tree People, American Forests, and private timber companies, have been successfully supporting reforestation projects on federal lands to help close the gap. Additional partnerships (e.g., with water agencies, recreation, and other industry groups) could expand the pool of reforestation support.

5. TAKING ACTION TO CLOSE THE REFORESTATION GAP

Rapidly increasing, wildfire-driven reforestation needs in California necessitate collaborative and strategic investments to sustain future forest cover. Because reforestation is an inherently complex, long-term process, enabling California's land managers and forest owners to successfully reforest after wildfire requires programs and strategies that acknowledge a changing climate and account for the suite of costs that are involved. The path forward to restore and protect long-term forest cover in California will entail increasing the efficiency and pace of the reforestation planning process, enhancing the supply of reforestation planting materials, increasing capacity for reforestation implementation, and encouraging the adoption of climate-informed reforestation practices. These considerations inform the final section of this strategy, which outlines four goals to create the conditions necessary to scale up reforestation and address California's reforestation gap.

Goal 1: Increase the Efficiency and Pace of Reforestation Planning

Planning reforestation projects involves determining where reforestation is needed and likely to succeed, ensuring regulatory compliance, and coordinating complex, multi-year initiatives. Reforestation is most financially efficient when projects are initiated in the first few years after a wildfire. To capitalize on this window of opportunity, multiple elements of the planning process must align, including access to spatial data and field resources to identify sites and planting units to be reforested, completion of regulatory compliance processes to obtain necessary clearances, and adequate funding to support all stages of the reforestation process.

Recent Progress and Accomplishments

New tools, data, and educational resources: A new, publicly available California reforestation toolshed website (https://reforestationtoolshed.com/) was launched by the USDA Climate Hub in partnership with CAL FIRE, USDA Forest Service, UC Cooperative Extension, and American Forests in 2025 to curate and organize reforestation planning and implementation resources. UC Agriculture and Natural Resources and partners have recently released an updated Reforestation Manual for California Conifers, a comprehensive guide for landowners and managers working to reestablish forests.

Current Challenges

- **Data availability:** Timely reforestation planning requires fire severity maps to assess burned areas, ideally targeting areas unlikely to regenerate naturally and where plantings are likely to succeed long term. Currently, data sources for these maps are limited to fires greater than 1,000 acres on forested public lands, which poses a challenge for reforestation after smaller fires or on private lands.

- **Complex coordination:** Reforestation often requires planning and coordination between a management team, landowners, seed collectors, nursery staff, and labor service providers. Implementing reforestation at a larger pace and scale often benefits from cross-boundary partnerships, which require further capacity for coordination.

- **Regulatory delays:** The pace of environmental compliance and documentation work needs to reflect the urgent and vast need to reforest. Demonstrating compliance with state and federal environmental regulations can result in costly project delays, and land management agencies often lack the capacity to execute on these requirements efficiently. Public lands reforestation projects have faced environmental litigation, which further slows accomplishments. In recent years, reforestation work has been done under post-wildfire emergency authorities and declarations from state and federal governments that can reduce some regulatory delays.

- **Funding delays:** When landowners need grant funding to initiate reforestation projects, the uncertainty of competitive grant programs and long delays to access project funding can slow down reforestation progress on the ground.

Key Actions

- **Support strategic prioritization:** The Task Force and its partners will consider how best to advance the proposed prioritization scheme, so that future fund allocations and reforestation project portfolios are more strategic and optimized for landscape-scale benefits.

- **Expand access to high-quality planning data:** Public agencies and institutions will continue developing and regularly make post-wildfire reforestation assessment (i.e., burn severity, natural regeneration likelihood, and future climate exposure) and planning tools available to the public to address the strategic planning needs of different landowner groups.

- **Plan before fires**: CAL FIRE and UC Cooperative Extension will continue to support and provide training for private forest landowners and USDA Forest Service managers to develop proactive, pre-incident forest management and reforestation plans for wildfire and other large-scale disturbances.

- **Plan during fires:** The Reforestation Working Group will develop a concept proposal describing how Resource Advisors (READs) and Burned Area Emergency Response (BAER) teams, when assigned to active incidents, could immediately begin developing restoration plans.

- **Facilitate environmental compliance:** Per the 2026 Wildfire and Landscape Action Plan, CNRA and CalEPA will consider how to provide regulatory relief to critical post-wildfire reforestation projects and prioritize efforts in areas most likely to be successful, while also upholding meaningful consultation with tribes and incorporating tribal priorities and knowledge into planning to protect cultural resources in post-fire landscapes.

Goal 2: Enhance Supplies of Reforestation Planting Materials

Successful reforestation requires high-quality seed supplies from diverse tree species, functional nursery infrastructure, and skilled personnel to manage seeds and produce seedlings. High-quality seedlings are more likely to survive the out-planting process;

increasing both the quality of seedlings and the diversity of species and seed zones represented in planting materials is key to successfully ramping up the pace and scale of reforestation statewide.

Recent Progress and Accomplishments

- **New partnerships and improved coordination:** The California Reforestation Pipeline Partnership (RPP) is a strategic collaboration between the United States Department of Agriculture Forest Service Region 5, CAL FIRE, and American Forests that was created to support post-wildfire reforestation on public and private lands. In 2024, 30% of the seed bushels collected for public seed banks were supported by efforts from the RPP.

- **Expansion of the plant materials workforce:** The California Cone Corps is a workforce development pathway program from the RPP that builds the pool of technicians needed to scale up reforestation. The Corps has placed over 40 trained members in positions that help address critical labor shortages at all stages of the reforestation process, including seed collection, seedling production, site prep, outplanting, and monitoring. Thanks to both a significant cone crop and the readiness of the cone collection workforce, deposits of cones to public seed banks in 2024 were up 275% from the total collected in 2023.

- **New plant materials infrastructure:** In the past three years, CAL FIRE invested $5.28M to develop and expand reforestation nursery facilities and cone collection capacity. This included a $3 million grant from CAL FIRE to Sierra Pacific Industries to help fund the construction of a conifer seedling nursery in Gazelle, California, to address native tree seedling shortages and support post-wildfire reforestation. The new facility produced 5 million seedlings in 2024 and aims to scale up production to reach 25 million seedlings annually.

- **Improved plant materials availability:** In 2025, total statewide conifer seedling production capacity was up nearly 50% from 2020 levels, at approximately 41 million seedlings a year, based on an email survey of the CA Forest Nursery Managers Association. Importantly, not all seedlings grown in California are planted in California. For example, the Placerville Forest Service nursery serves post-wildfire needs across the Western U.S., and the SPI nursery in Gazelle supports SPI needs in Oregon, Washington, and California. The approximate public-private split of conifer seedling production capacity statewide as of 2025 is 12% public, 88% private. While a meaningful portion of seedlings grown in California are planted out of state, in theory, the 41 million seedlings grown in-state could reforest 273,000 acres of severely burned forestlands a year if planted 150 stems per acre.

Current Challenges

- **Threats to natural seed supplies:** Climate change is expected to impact the variability and synchronicity of seed production (Bogdziewicz et al., 2021). Mortality of mature, cone-producing trees from climate-driven stressors, such as wildfire, insects, and disease, has resulted in reduced cone production and reduced genetic diversity.

- **Inherent annual variability:** Cone crop yields and the demand for nursery-grown seedlings fluctuate annually, complicating resource allocation and staffing processes, necessitating highly flexible and agile nursery infrastructure and operations.

- **Sustaining the cone collection and nursery workforce:** Workforce availability is a challenge in all parts of the reforestation pipeline and has been impacted by recent changes to immigration policies and federal workforce levels. While nursery capacity has grown significantly since 2021, sustained investments in the nursery and cone-collecting workforce are still needed. Only a handful of cone collection contractors operate in California, with one holding ~90% of contracts, and agency employees often lack the necessary training to collect cones themselves. Nurseries compete for the same limited-sized seasonal labor pool as the broader agricultural sector.

Key Actions

- **Strategically enhance the seed supply:** The California Reforestation Pipeline Cooperative will advance a California Forest Seed Strategy based on data and input from the USDA Forest Service, CAL FIRE, Bureau of Land Management, Tribal, and private sector partners. Actions will address targets for wild collection and orchard seed production, staffing needs, workforce development, and cross-jurisdictional coordination to procure sufficient seed supply for reforestation activities across all lands in California.

- **Continue workforce investments:** UC Agriculture and Natural Resources, American Forests, CA Assoc. of Resource Conservation Districts, and their partners will increase availability of vocational and training opportunities for all steps in the reforestation pipeline in line with continued investment in programs like Cone Corps, Cone Camp, Reforestation Camp, and UCANR's California Tree School. This work will be guided by the findings and recommendations in the Forest Sector Workforce Study Report wherever possible.

Goal 3: Increase Capacity for Reforestation Implementation

Simply put, reforestation capacity in California is not commensurate with the need to reforest lands affected by high-severity wildfires. The USDA Forest Service lacks the budget and staff to address annual wildfire-driven reforestation needs, let alone the backlog. Fortunately, there has been a sharpened interest in and investment for addressing the reforestation gap in recent years from CAL FIRE, Resource Conservation Districts, NGOs like American Forests, the National Forest Foundation, and Tree People, among others, as well as private foundations and various public-private partnerships.

Recent Progress & Accomplishments

- **Post-wildfire support for small parcel private landowners**: The 2021 Wildfire and Forest Resilience Action Plan recommended the formation of Emergency Forest Restoration Teams (EFRTs) to assist small parcel private landowners after wildfire. The EFRT model entails the use of local agencies to rapidly assist private forest landowners using public disaster relief funding. Since their establishment, EFRTs have

assisted 1,065 landowners, treating 10,638 acres of post-wildfire landscapes. An initial assessment of EFRT pilots in response to the Dixie, Tamarack, and Caldor fires found that EFRTs are a successful model for rapid forest restoration assistance on private lands and that, going forward, EFRTs and state and federal cost-share programs can work together to increase the pace and scale of restoration. Following the success of the pilot EFRTs, more have been established with 13 RCDs statewide, responding to the impacts of 21 wildfires. EFRTs have been established with Butte County RCD, Coarsegold RCD, El Dorado RCD, Feather River RCD, Honey Lake Valley RCD, Humboldt County RCD, Inland Empire RCD, Placer County RCD, RCD of Tehama County, Shasta Valley RCD, Sierra RCD, Solano RCD, and Western Shasta RCD.

Current Challenges

- **Skilled workforce availability:** There has been a long-standing scarcity of workers with the skills and experience to implement reforestation projects, from salvage logging to vegetation management and planting seeds and seedlings. Reforestation efforts are often forced to compete for workers with other types of forest sector and wildfire work opportunities. Foreign workers on temporary non-immigrant H-2B (non-agricultural worker) visas are integral to the American forest sector, particularly for tree planting (McDaniel & Casanova, 2005). H-2B visas cover a wide range of sectors in addition to the forest sector (e.g., construction, landscaping, hospitality). Unlike agricultural worker H-2A visas, which have no annual quantity cap, there is a longstanding annual limit to the number of H-2B visas available. According to the Congressional Research Service, demand for H-2B visas has exceeded supply for the past decade, creating competition between the forest sector and other employers and sectors for this visa type.

- **Constrained wood utilization options:** Widespread wildfire-driven tree mortality in recent years has overwhelmed California's sawmill and other wood products infrastructure and wood markets, particularly because there are far fewer operational mills in California today than there were in the late 20th century. Post-wildfire salvage logging of merchantable timber can generate revenue to offset the costs of reforestation, but this option is not available in all situations, with private industrial landowners generally best positioned to act quickly and realize revenue through post-wildfire salvage logging sales.

- **Monitoring capacity constraints:** Without long-term monitoring, practitioners and researchers lose valuable knowledge about the efficacy of reforestation project design and implementation. There is currently no statewide dataset that tracks or reports the success rates of reforestation projects over time.

Key Actions

- **Continue workforce development efforts:** The California Reforestation Pipeline Partnership will grow the "Cone Corps" workforce development pathway at the pace of partner demand and available funding to fill needed workforce gaps along the reforestation supply chain with public and private partners.

- **Expand Tribal stewardship in post-fire landscapes:** Per several key actions in the draft 2026 Wildfire and Landscape Resilience Action Plan, state and local agencies will work to include tribes in planning and implementation of wildfire recovery projects, including in Emergency Forest Restoration Teams (EFRTs), to ensure Tribal inclusion before and during recovery work to protect Tribal cultural resources. State and federal agencies will seek opportunities to enter into meaningful and durable Tribal access and collaboration agreements to support restoration of landscape health, which on federal lands could include agreements through the Good Neighbor Act or Tribal Forest Protection Act with federally recognized tribes for post-fire reforestation projects.

- **Expand reforestation education**: The Reforestation Pipeline Cooperative will identify curriculum opportunities to train future reforestation practitioners, building on UC Cooperative Extension's expertise in providing practical training for diverse audiences, including their online program for private forest landowners.

- **Increase dedicated funding within existing mechanisms:** The Task Force will consult with agencies administering existing program funds (i.e., Wildlife Conservation Board, Regional Forest and Fire Capacity Program, and CAL FIRE Forest Health and Regional Wildfire & Landscape Resilience grant programs) to indentify opportunities to explicitly advance post-wildfire forest recovery planning and landscape-scale implementation of reforestation.

Goal 4: Expand the Adoption of Climate-Informed Reforestation Practices

The need to moderate climate impacts on forests and young plantations is motivating land managers to incorporate climate-informed practices in their reforestation projects. Today's reforestation projects must account for current and future climatic conditions to produce healthy forests that are resilient to wildfire impacts, but institutionalizing these practices requires overcoming barriers to adaptation and empowering practitioners with the knowledge and skills to apply climate-informed practices to their local context.

Recent Progress & Accomplishments

- **Developments in climate-smart planning:** In partnership with federal, state, and NGO practitioners and scientists, the USDA California Climate Hub, with support from CAL FIRE, released a set of regional and vegetation type-specific reforestation guidance documents in 2025. These documents offer forest-type-specific recommendations for incorporating climate considerations into reforestation activities for inland forests across California.

- **Pilot projects in National Forests**: Several National Forests in California have initiated or are currently planning small-scale pilot projects using climate-informed reforestation techniques. The use of microsites, which can protect young seedlings from warm and dry conditions, and non-gridded ICO (Individuals, Clumps, and Openings) seedling planting designs, often incorporating lower planting densities, are being piloted in these projects. These pilots also offer the opportunity to train planting contractor crews in non-gridded planting techniques. The pilots will be

closely monitored, and lessons learned may inform future reforestation efforts in California's National Forests.

Current Challenges

- **Synthesizing and applying new knowledge:** Land managers have limited bandwidth to consider, contextualize, and integrate new research and resources into their planning and implementation processes. Yet findings from emerging research can be critical to efficient and effective reforestation projects.

- **Institutional limits on adaptation:** Land managers may need the flexibility to modify planting specifications to best suit the anticipated climate or features of a project site, but government guidelines that establish stocking standards (i.e., planting densities), which are present in both federal and state contexts, can limit their ability to do so.

- **High-quality and context-specific data:** Strategically choosing locations for reforestation projects requires readily available, current, and high-quality data that identify where planting is necessary, likely to succeed, and operationally feasible. Land managers may lack the data or insights required to make timely, efficient, and science-based decisions about where and how to reforest.

Key Actions

- **Evaluate State reforestation standards:** The Board of Forestry and Fire Protection will consider regulatory updates and rulemaking to potentially modernize reforestation standards and post-disturbance reforestation rules under the California Forest Practice Rules.

- **Expand climate-informed reforestation education and knowledge-sharing:** The Task Force, CAL FIRE and the Reforestation Pipeline Cooperative will work through UC ANR extension networks and practitioner communities to promote climate-informed reforestation guidance and post-fire assessments that strategically prioritize post-fire landscape treatments to promote long-term resilience, drawing on existing outreach models from state, federal, and nonprofit partners.

CONCLUSION

High-severity wildfires in California's forests since 2000 have resulted in the need to reforest more than 2.3 million acres. To sustain the state's culturally, economically, and ecologically important forests, investments in the plant materials, infrastructure, and workforce for reforestation have supported more than 254,000 acres of reforestation statewide since 2020. Yet the need to reforest still significantly outpaces accomplishments. More than one million acres of previously forested lands that burned at high severity in the most recent 5-year period remain untreated and may be at risk of type conversion to non-forest. Climate-based projections of future wildfire extent and wildfire-driven reforestation needs suggest that the need to reforest will remain substantial over the next 10-year period, yet a lack of landscape-scale data assessing reforestation project success and long-term outcomes make it difficult to estimate the effectiveness of recent efforts.

Addressing the reforestation gap and mitigating the social and ecological costs of forest loss will require strategically prioritizing how existing reforestation resources are used, scaling up reforestation treatments statewide, and investing in the people and systems needed to increase long-term reforestation project successes as part of a holistic commitment to restoring ecosystem health across California. We propose triaging reforestation needs based on a combination of human safety needs, ecosystem service values, and strategic opportunities to expand project boundaries. While not all acres of reforestation need are feasibly treatable, scaling up reforestation is nonetheless required to sustain forest levels across the state, particularly in a warmer and drier climate.

The long-term protection of California's forests will require reforestation and active forest management to mitigate future wildfire severity. Climate change will make both categories of action more necessary and more complex as the ranges of different forest types shift and contract, and young forests experience climate stress. Strategic investments and partnerships to increase the efficiency and pace of the reforestation planning process, enhance the supply of reforestation planting materials, increase capacity for reforestation implementation, and encourage the adoption of climate-informed reforestation practices are foundational to the growth and success of reforestation efforts statewide.

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APPENDX A. SUPPLEMENTAL REFORESTATION NEED INFORMATION

Table A1. Top 35 wildfires since 2020 in terms of fire-related reforestation needs

Counties with reforestation needs related to each fire were identified by overlaying the reforestation needs for each fire with a statewide county map. Acres of need listed here do not account for any reforestation treatments that may have been conducted, so current untreated needs may be lower than what is listed.

Fire name	Year	Est'd. Acres of Reforestation Needs	Counties with Reforestation Needs Related to Fire
Dixie	2021	333,070	Butte, Lassen, Plumas, Shasta, Tehama
August Complex	2020	237,680	Glenn, Lake, Mendocino, Shasta, Tehama, Trinity
North Complex	2020	143,164	Butte, Plumas
Creek	2020	97,158	Fresno, Madera
Caldor	2021	75,653	Alpine, Amador, El Dorado
Slater	2020	65,344	Del Norte, Siskiyou
Park	2024	51,588	Butte, Tehama
Antelope	2021	46,566	Siskiyou
Haypress	2021	46,287	Siskiyou, Trinity
Castle	2020	41,344	Tulare
Monument	2021	38,755	Trinity
Kelly	2023	28,379	Del Norte
Windy	2021	27,942	Tulare
Sugar	2021	26,881	Lassen, Plumas
McFarland	2021	23,567	Shasta, Tehama, Trinity
McKinney	2022	23,437	Siskiyou
Red Salmon Complex	2020	19,614	Humboldt, Siskiyou, Trinity
CZU Aug Lightning	2020	18,813	San Mateo, Santa Cruz
Mosquito	2022	15,538	El Dorado, Placer
KNP Complex	2021	12,651	Tulare
Tamarack	2021	12,440	Alpine, Mono
Glass	2020	12,421	Napa, Sonoma
Sheep	2020	12,338	Lassen, Plumas
McCash	2021	12,241	Siskiyou
Bobcat	2020	8,135	Los Angeles
Bridge	2024	7,986	Los Angeles, San Bernardino
Caldwell	2020	6,981	Modoc, Siskiyou
W-5 Cold Springs	2020	6,519	Lassen, Modoc
Loyalton	2020	5,664	Lassen, Plumas, Sierra
Lava	2021	5,579	Siskiyou
Shelly	2024	5,283	Siskiyou
Gold	2020	5,245	Lassen
Apple	2020	5,225	Riverside, San Bernardino
Tennant	2021	4,766	Siskiyou
Mountain	2022	4,376	Siskiyou