Preliminary Reporting on Outcomes of Wildland Fire Resilience Treatments 2020-2024

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In support of the California Wildfire and Forest Resilience Task Force Monitoring, Reporting, and Assessment Work Group

Recommended Citation: Eitzel, MV, Cox, L, Battles, J. "Preliminary Reporting on Outcomes of Wildland Fire Resilience Treatments 2020-2024." Report prepared for the California Wildfire and Forest Resilience Task Force Monitoring, Reporting, and Assessment Work Group. https://doi.org/10.58076/C63W21

Summary:

In this report, we present a pilot of outcome reporting for wildland and wildland urban interface (WUI) fire resilience treatments. We focus on the contributions of vegetation treatments towards reducing vegetation stress and wildfire risk as key management objectives, while also reporting on potential co-benefits of habitat and water protection (additional potential co-benefits are beyond the scope of this pilot). We identified treatments that could impact relevant vegetation characteristics using data from the California Interagency Treatment Tracker System (ITS) from October 2020 through December 2024. Based on the availability of other data sources in 2025 (largely datasets updated as of 2024), we were able to calculate how frequently the treatments were implemented in areas identified as high priority according to the different management objectives; we also estimated the potential efficacy of the treatments in reducing vegetation stress and wildfire risk. We found that, statewide, treatments since late 2020, in aggregate, do not appear to have been targeted towards the most drought-vulnerable forested areas, but where treatments were implemented in those areas (in late 2020 through late 2024), the treatments did have a potentially meaningful reduction in drought-vulnerability. Between late 2020 and late 2024, treatments in shrublands have not resulted in increased grass-dominated areas; and, since late 2020, treatments within shrublands have targeted roadside areas, which may then be mowed to reduce ignition potential. Potentially beneficial (low-intensity) fire increased moderately statewide inside treatments, but increased more within fire footprints. Despite no overarching policy requirements or large-scale cross-organization planning, treatments within the WUI, road corridors, and especially in areas adjacent to utility corridors were collectively preferentially implemented in high wildfire hazard areas. The aggregated treatment extent in the WUI modestly reduced potential high severity fire, and in areas adjacent to utilities and roads moderately reduced it. Though in general treatments may not have been designed to specifically improve habitat or water resources, their locations were also somewhat concentrated in high priority areas. Finally, when evaluating only areas within treatments where we could observe a change in canopy cover via remote sensing imagery, reduction in tree drought vulnerability and reductions in potential wildfire severity are meaningful, and more similar to impacts of fires - but potentially without the other detriments of fires.

About this series

This document is one of a series of work products prepared by science staff for the California Wildfire and Forest Resilience Task Force Science Advisory Panel. Its purpose is to provide scientific analysis and synthesis in support of the Task Force's mission of achieving wildfire resilience across California's fire-adapted forests and shrublands. These products are intended to advance coordination, shared understanding, and informed decision-making among the many agencies, organizations, and communities engaged in wildfire mitigation and landscape stewardship. They summarize current scientific understanding, evaluate management approaches and tradeoffs, identify knowledge gaps, and inform planning, monitoring, and reporting efforts. While these documents have received feedback from a variety of contributors, they are not formally peer-reviewed. They are published in eScholarship, a public repository, so that the underlying science is openly available and citable to these audiences.

The analyses and interpretations presented here reflect the best available information at the time of preparation and are intended to aid discussion and learning in a rapidly evolving scientific and management context. As new research, monitoring results, and practitioner experience emerge, findings and recommendations may also evolve. Unless explicitly stated otherwise, these materials do not represent formal consensus recommendations of the Science Advisory Panel.

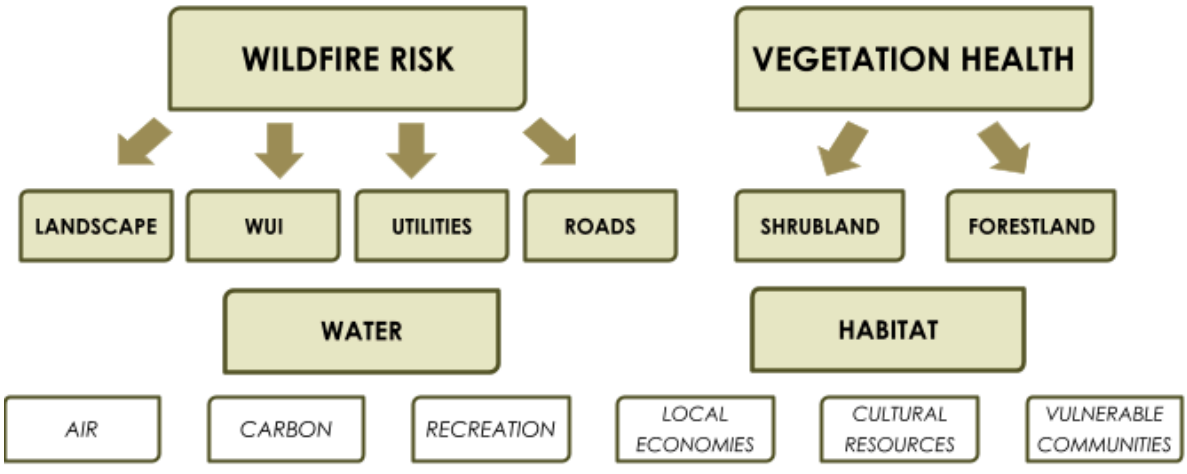
About this document

This report shares a set of potential methods for reporting outcomes of fire resilience vegetation management. It follows the previously developed framework on outcome reporting found elsewhere in this series, giving examples of targeted effort and efficacy reporting for a subset of the dimensions of resilience for which we had data in 2025. It demonstrates some of the challenges in and the potential for doing statewide reporting of outcomes and can inform future efforts.

Background

Reporting the outcomes of fire resilience treatments involves first identifying and prioritizing the important policy and management objectives of the treatments. Different types of managers, policymakers, organizations, and communities may prioritize certain social-ecological topics and their associated objectives differently: air quality may be a higher priority for an air resources agency, water supply may be a higher priority for a water management agency, and vegetation- and/or fire-related agencies may focus on vegetation health and wildfire risk. Due to our disciplinary background and our work with the California Department of Forestry and Fire Protection (CAL FIRE) and the California Wildfire and Forest Resilience Task Force, for this pilot analysis we focus on improvement of social-ecological fire resilience via **reduced vegetation stress** and **wildfire risk reduction** which are most directly impacted by vegetation treatments. Additionally, we track treatment impacts on the co-benefits of **protecting habitat and water resources** (Figure 1), and note that other areas of resilience are important to track and could be the focus of future efforts.

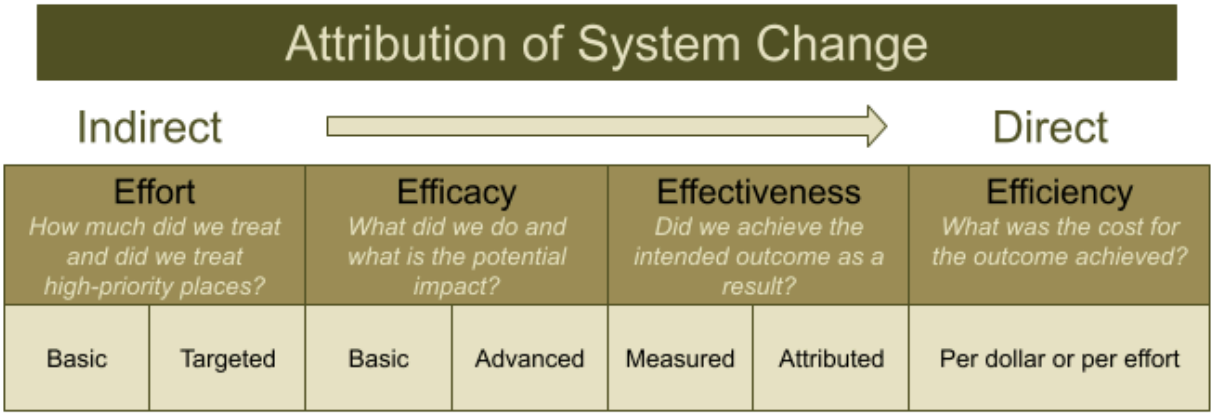
***Figure 1**: Topic areas for priority policy/management objectives, abstracted from Pillars of Resilience, the Wildfire Resilience Index, and the Montreal Process.*[1] *In this report, wildfire risk is divided up by management context (whole landscape, Wildland-Urban Interface only, utility corridors only, and road corridors only), and vegetation health is divided up by ecosystem (shrubland and forestland). Other co-benefits are shown, but appropriate metrics for reporting outcomes of treatments are still under development.*



[1] See section 1 of Eitzel, MV, Cox, L, Battles, J. "Framework for Measuring and Reporting Wildland Fire Resilience Treatment Outcomes." Report prepared for the California Wildfire and Forest Resilience Task Force Monitoring, Reporting, and Assessment Work Group. https://doi.org/10.58076/C67P4Z

After defining these objectives, we aim to attribute potential ecological and social benefits to treatments as directly as possible, given data availability, amount of area treated, and how quickly benefits may become measurable. Specifically, for this report, targeted effort explores the degree to which implemented past projects align with priority places for a given current given policy objective (but not what the impacts might be). Efficacy calculates a potential impact of treatments on a particular outcome of treatments aligned with that policy goal (Figure 2). We focus on these two parts of the attribution spectrum due to the availability of spatially-explicit metrics to appropriately address the priority topics of wildfire risk and vegetation health (for effort and efficacy), and the co-benefit topics of water and habitat (for effort).

Figure 2 Diagram showing a range of approaches to measuring potential benefits of management actions.[2]



Therefore, based on the currently available data (circa 2025), we focus in **section (1) on targeted effort** for reduced vegetation stress, wildfire risk reduction, and protecting habitat and water; and **efficacy in section (2)** only for the policy objectives of reduced vegetation stress and wildfire risk reduction. We first give the details of methods and results for targeted effort and efficacy, and at the end of the document summarize the results in terms of the topic areas in Figure 1. Note that sufficient data are not available at the time of this writing to reliably establish effectiveness of treatments by empirically measuring their impacts when a fire occurs,[3] and efficiency methods would depend on

[2]See section 2 of Eitzel, MV, Cox, L, Battles, J. "Framework for Measuring and Reporting Wildland Fire Resilience Treatment Outcomes." Report prepared for the California Wildfire and Forest Resilience Task Force Monitoring, Reporting, and Assessment Work Group. https://doi.org/10.58076/C67P4Z

[3] For an example of an early attempt to use causal inference statistical methods to determine effectiveness of low intensity fires to reduce future high intensity fires, see Wu, X., Sverdrup, E.,

judgments regarding whether dollars or person-hours would be a more appropriate way to determine the tradeoff between effectiveness and cost. Also, in these examples, we do use thresholding for targeted effort to highlight priority areas, and for basic efficacy to simplify metrics, but do not make use of thresholding in determining target ranges that management is aiming to achieve.[4] We note that this could be done in the future using a consensus approach.[5] We also note that non-spatial summaries may also be appropriate for these policy objectives, but do not demonstrate them here.

The R scripts used to generate the results in this report are hosted on GitHub[6] and the data available in 2025 that we used are hosted on the Environmental Data Initiative.[7]

(1) Targeted Effort

Methods of Targeted Effort Calculations

Our approach to measuring targeted effort is to identify high-priority areas according to each policy objective, and then report on what proportion of our treated areas have been done in high priority areas (comparing this proportion with how common those areas are overall). We follow these steps:

1. **Filter Treatments for Policy Objective**: Not all treatments may be intended for or able to provide impact for all policy objectives, so we filter for treatment types that are likely to apply to a given policy objective. Given the short timeframe of treatment data availability in the current monitoring context, we aggregate the selected treatment footprints together for multiple years into one larger footprint.

Mastrandrea, M. D., Wara, M. W., & Wager, S. (2023). Low-intensity fires mitigate the risk of high-intensity wildfires in California's forests. Science advances, 9(45), eadi4123. The authors have included all low-intensity fires, not just prescribed fires, noting that there was not enough prescribed fire treatment to gain enough statistical power to test the impacts of treatments specifically. This study also uses remote sensing to identify fires and therefore cannot assess mechanical treatment effectiveness.

[4] See section 3 of Eitzel, MV, Cox, L, Battles, J. "Framework for Measuring and Reporting Wildland Fire Resilience Treatment Outcomes." Report prepared for the California Wildfire and Forest Resilience Task Force Monitoring, Reporting, and Assessment Work Group. https://doi.org/10.58076/C67P4Z

[5] Similar to the policy-informed scientific Delphi process in Eitzel, M.V., Battles, J., Smith, J., Ostoja, S. (2024) "California Wildfire Resilience Core Metrics Rating Process and Results." Report prepared for the California Wildfire and Forest Resilience Task Force. https://doi.org/10.58076/C6MW2P

[6] https://github.com/mveitzel/Fire-Resilience-Treatment-Outcome-Reporting-Pilot

[7] Eitzel, M. and L. Cox. 2026. California Wildfire Resilience Vegetation Management Outcome Reporting Pilot Data ver 1. Environmental Data Initiative. https://doi.org/10.6073/pasta/853aaedfdbea02e99cfe1d8198331586 (Accessed 2026-06-12).

See Appendix A for a list of which treatments we assigned to which policy objectives.
e.g. Reforestation (post-fire replanting) -> Forest Health, not Fire Risk Reduction

2. **Choose and Threshold Metrics for "High Priority" Areas Aligned with Policy Objective**: For a given objective, use a metric for which scientists, policymakers, and managers can determine a threshold to indicate which areas of the landscape to prioritize. Mark pixels above the threshold as a '1' and those below it with a '0' or a similar binary coding scheme in order to summarize areas.
e.g. for protecting biodiversity, Areas of Conservation Emphasis category 4 or 5 are assigned "1" as high-priority.
3. **Subset Geographically as Needed for Ecosystem Type or Management Context**: Some policy objectives make sense only for one ecosystem type or management context, so the metric should be spatially restricted only to the applicable area.
e.g. for Forest health, use Drought Vulnerability Index, but only in Wildlife Habitat Relationship vegetation classes of 'Forest'.
4. **Calculate proportion within Treatment Areas that was "High Priority"**: Also, compare with the 'background proportion' of that priority layer - how much of the landscape is in that condition. Was the proportion of the treated area that was high priority higher than the overall proportion of the landscape that is high priority?
e.g. in Wildlands, xx % of treated areas were in WHP classes 4 or 5 (high fire risk), compared to yy % of all wildlands in WHP classes 4 or 5.

Below, we expand on each of the steps listed above and share the results of each step demonstrated with our available data for our key policy objectives.

Filter Treatments for Policy Objective

Potential areas treated may differ between policy goals, so the first step of our analysis is to filter the treatments for those that are likely to affect a given policy objective. For example, the amount of area treated with reforestation may contribute to improved Forest Health, but may not contribute to reducing wildfire risk. These areas will be necessarily smaller than the areas in the Interagency Treatment Tracking System dashboard because we can only make use of the polygonal data (not lines e.g. roadside treatments from CALTRANS, not points e.g. utility pole treatments, and not

aspatial data e.g. non-spatial timber company data). Table 1 shows the results of mapping treatment types to different policy goals, and the resulting total potential area that could apply to a given goal (see appendix A for specific treatment types in the Interagency Treatment Tracker we associated with which policy goals for this filtering step).

Table 1: For each policy topic area, we filtered the Interagency Treatment Tracker polygons for types of treatments appropriate for that policy topic area. Note that this is only based on the type of treatment, not on the vegetation type or other contexts, and represents the maximum area the treatments from Fall 2020 to mid 2025 could affect based on their treatment type. The acres represent footprints (i.e. 1 footprint acre can represent many activities), and the different topic areas overlap.

Policy topic area	**Thousands of Acres of ITS Treatments**
Wildland/WUI/Utility Corridor Fire Risk	1,161
Forest Health	1,247
Shrubland Health	1,060
Habitat	1,037
Water	915

Choose and Threshold Metrics for "High Priority" Areas Aligned with Policy Objective

We then select metrics for each policy objective and threshold them to indicate what areas of the landscape are 'high priority' for that objective (Table 2). In the table, we also share the 'current condition' of each priority metric in 2024 (or as most recently available), e.g. how many acres in the wildland fall into the 'high' and 'very high' Wildfire Hazard Potential categories, for context when we report what proportion of treatments (with appropriate treatment types) were in those priority areas. We identified 'high priority areas' according to each policy objective as follows (Table 2, Figure 3).

Table 2: For each policy target, we share the metrics, their sources, and the thresholds we used to declare an area to be "High priority" according to that policy target. We

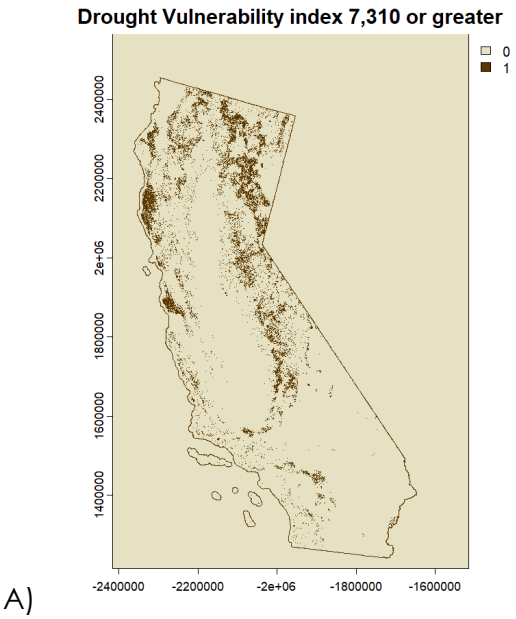
also list the area of that high priority area statewide. FRAP = Forest and Range Assessment Program; CECS = California Ecosystem Climate Solutions; WHR = Wildlife Habitat Relationships; OSM = Open StreetMap. CGS = California Geological Survey; CDFW = California Department of Fish and Wildlife; ACE = Areas of Conservation Emphasis. See Appendix B for more information on CECS layers.

Policy Target	**Metric**	**Source**	**Threshold**	**Area (Acres)**
Fire Risk	Wildfire Hazard Potential	Pyrologix (CALFIRE FRAP 2022, SIG reclassified 2024)	Hazard Category 4 or 5[8]	21,288,422
Fire Risk	Flame Length	CECS (2020)	Flame Length > 8 ft[9]	22,618,389
Forest Health	Drought Vulnerability	CECS (2020)	Vulnerability Index >=7,310, equivalent to relative SDI Max for "imminent mortality"[10]	9,636,561
Shrubland Health/ Protection	Road Proximity	CALFIRE WHR (2023) & CALTRANS Functional Road Classifcation (2022)	500 ft road buffer in shrublands[11]	2,310,023
Water	Hydropower	Bales & Guo (2025) (see appendix C)	Watersheds w/powerhouses >= 30KW[12]	13,965,825
Water	Debris Flow Potential	CGS (2025)	Watersheds with risk in the top 20%[13]	14,620,453

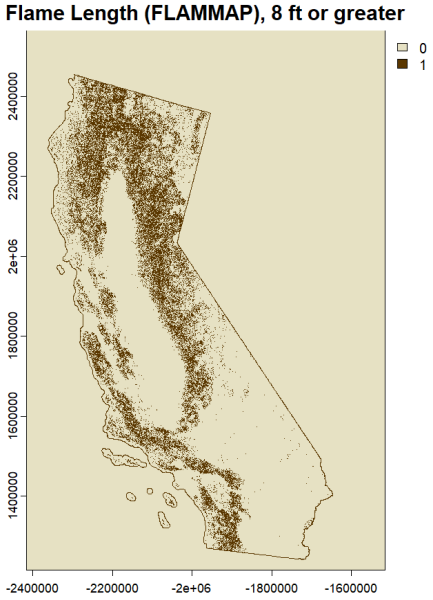
[8] Categories 4 and 5 are often used by a variety of entities for prioritizing management action.
[9] Flame length above 8 feet is more difficult to suppress and is more likely to catch the tree's crown on fire.
[10] See Appendix B for more on using quantile matching to associate the drought vulnerability metric with relative Stand Density Index maximum.
[11] This buffer width was used in other calculations done for the Task Force's Action Plan update, so we chose the same buffer for consistency.
[12] See Appendix C for more information on the hydropower metric.
[13] Based on advice from the creators of the dataset from the California Geological Survey.

Policy Target	Metric	Source	Threshold	Area (Acres)
Habitat	Critical Habitat	CDFW ACE (2018)	Species Diversity Category 4 or 5[14]	40,256,162

Figure 3: Priority Layers. A) Drought Vulnerability from CECS, B) Flame Length from CECS, C) CDFW ACE species diversity, D) CGS Debris Flow likelihood, E) Watersheds feeding Hydropower houses, F) CALFIRE/Pyrologix Wildfire Hazard Potential, G) CALFIRE WHR type "Shrub" within 500 feet of CALTRANS functional road classification roads.

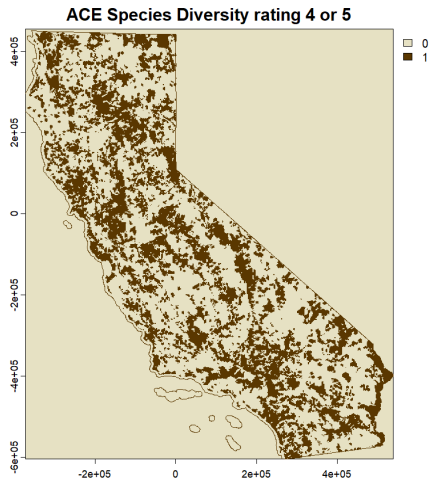


A)

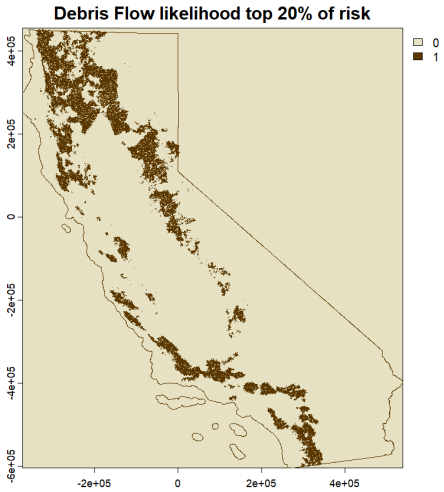


B)

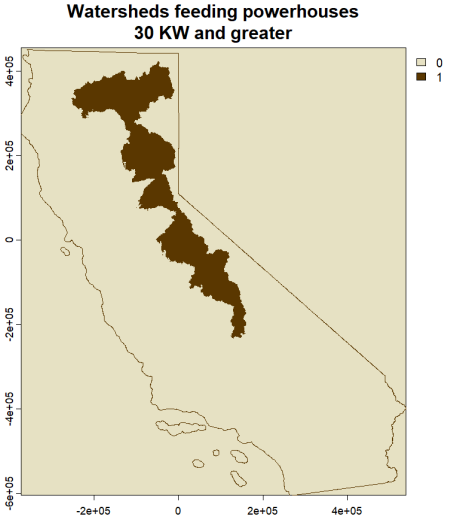
[14] Following the State of California's AB 63 analysis: https://34c031f8-c9fd-4018-8c5a-4159cdff6b0d-cdn-endpoint.azureedge.net/-/media/calfire-website/about/resources/legislatively-mandated-reports/sb-63-healthy-forests-and-fire-prevention-programs-funding-report-final.pdf?rev=262ed66341bd4051a2b888e8c89b5bec&hash=0A21EB3B39601BC330F5567C6F925470


ACE Species Diversity rating 4 or 5
0
1
4e+05
2e+05
0
-2e+05
-4e+05
-6e+05
-2e+05
0
2e+05
4e+05

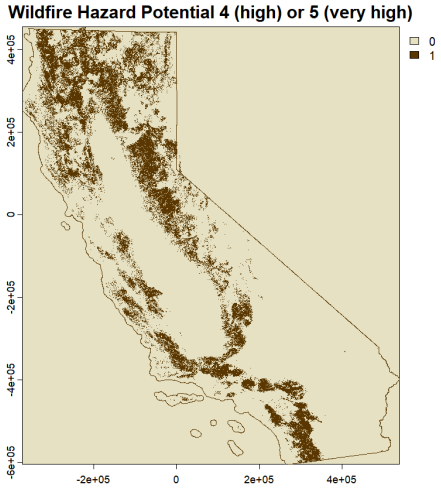
C)


Debris Flow likelihood top 20% of risk
0
1
4e+05
2e+05
0
-2e+05
-4e+05
-6e+05
-2e+05
0
2e+05
4e+05

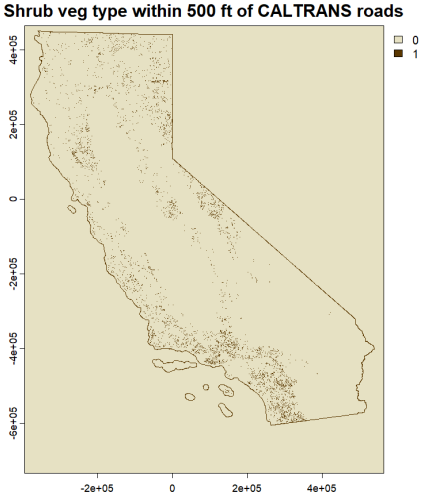
D)


Watersheds feeding powerhouses
30 KW and greater
0
1
4e+05
2e+05
0
-2e+05
-4e+05
-6e+05
-2e+05
0
2e+05
4e+05

E)


Wildfire Hazard Potential 4 (high) or 5 (very high)
0
1
4e+05
2e+05
0
-2e+05
-4e+05
-6e+05
-2e+05
0
2e+05
4e+05

F)


Shrub veg type within 500 ft of CALTRANS roads
0
1
4e+05
2e+05
0
-2e+05
-4e+05
-6e+05
-2e+05
0
2e+05
4e+05

G)

Subset Geographically as Needed for Ecosystem Type or Management Context

Because some policy goals are only applicable in some geographic areas, and some metrics are ecosystem specific, we subset some of these priority layers as needed. To address policy objectives regarding community protection, we subset the data for only WUI areas; similarly for road corridors, and also for utility corridors. We also subset the data on forest health only to CALFIRE WHR Forest types, and shrub health and protection only to WHR Shrub types (Table 3, Figure 5).

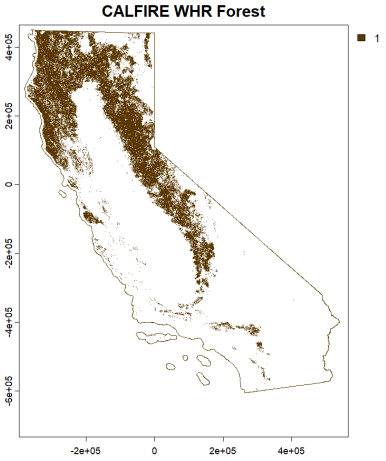
Table 3: Areas statewide for each geographical subset. Forest (including both conifer and hardwood but not including woodland), Woodland, Grassland, and Shrub (from WHR-13 classification), WUI (Interface and Intermix from FRAP), and All Landscapes (non agriculture, urban, or water). The Utility corridors include Transmission lines from PG&E, SCE, and SDGE, and the Road corridors use Public Road Functional Classification data from CALTRANS; roads are buffered 500 ft on either side of the street centerline, and utilities are buffered 1000 ft on either side of the utility line.[15] The background proportion of high priority area for an example metric for each area is indicated in parentheses.

Subset of State	**Area (Acres)**	**Proportion in High Priority Areas**
All Fire Prone Landscapes	84,411,772	0.25 (Wildfire Hazard Potential)
WUI	4,752,168	0.19 (Wildfire Hazard Potential)
Road Corridors	23,896,746	0.18 (Wildfire Hazard Potential)
Utility Corridors	5,037,412	0.10 (Wildfire Hazard Potential)
Forest	22,866,765	0.32 (High Drought Vulnerability)
Shrub	13,326,880	0.17 (Proximity to Roads)
Woodland	9,258,109	0.39 (Wildfire Hazard Potential)
Grassland	11,545,358	0.09 (Wildfire Hazard Potential)

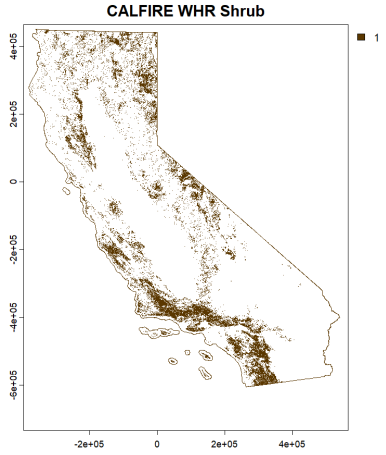
[15] Utility Rights of Way generally extend 50-125 ft on either side of the utility line. For justification of the 1000 ft buffer, see Liberty Utilities Corridor Resilience Project Decision Memo, USDA FS LTBMU. 2002. https://usfs-public.app.box.com/v/PinyonPublic/file/935070772254

We show these stratifications below (Figure 4).

Figure 4: Areas of California included in various subsets for different targeted effort calculations. A) "Forest" as defined in CALFIRE's WHR layer. B) CALFIRE's "Shrub" category. C) "Landscape" meaning all fire-prone areas (urban, agricultural, and water areas excluded), D) "WUI" as defined by CALFIRE (interface and intermix). E) Areas around roads from CALTRANS. F) Areas around transmission lines from utilities (PG&E, SCE, SDGE). G) "Woodland" as defined in CALFIRE's WHR layer. H) CALFIRE's "Grassland" category.



A)



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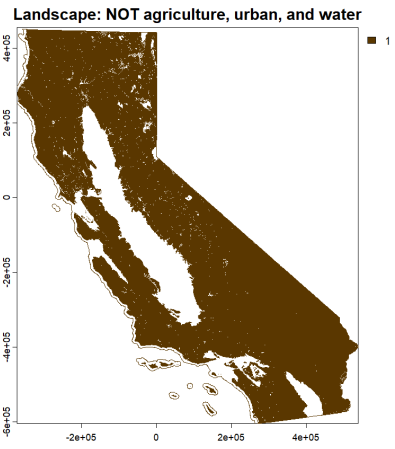

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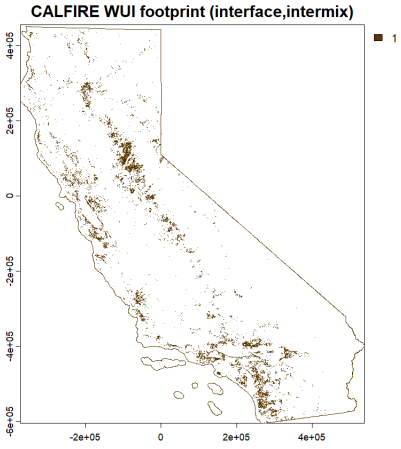

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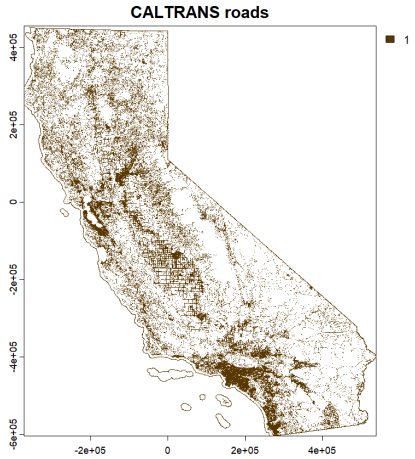
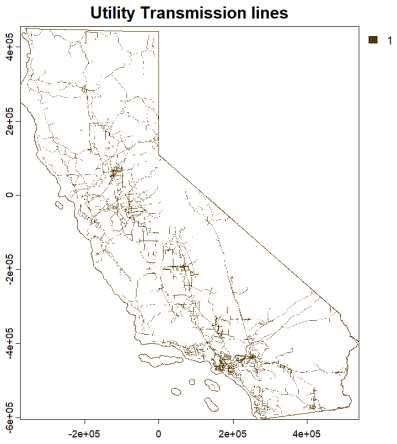


E)



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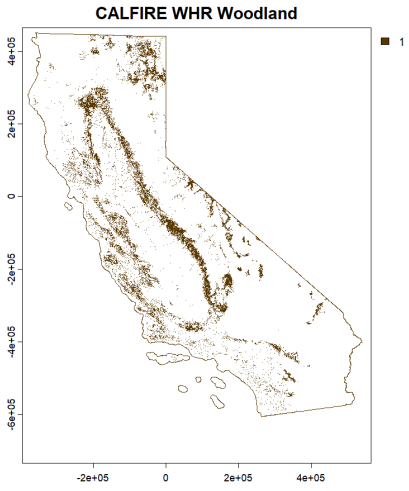

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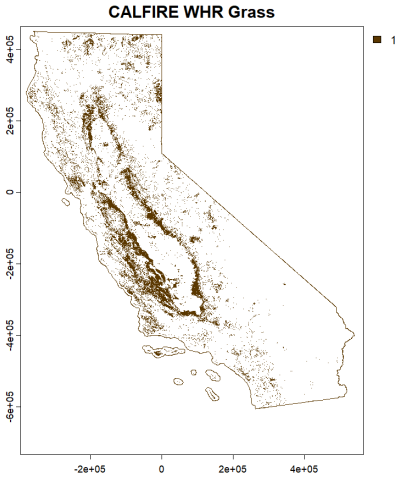


H)

Calculate proportion within Treatment Areas that was "High Priority"

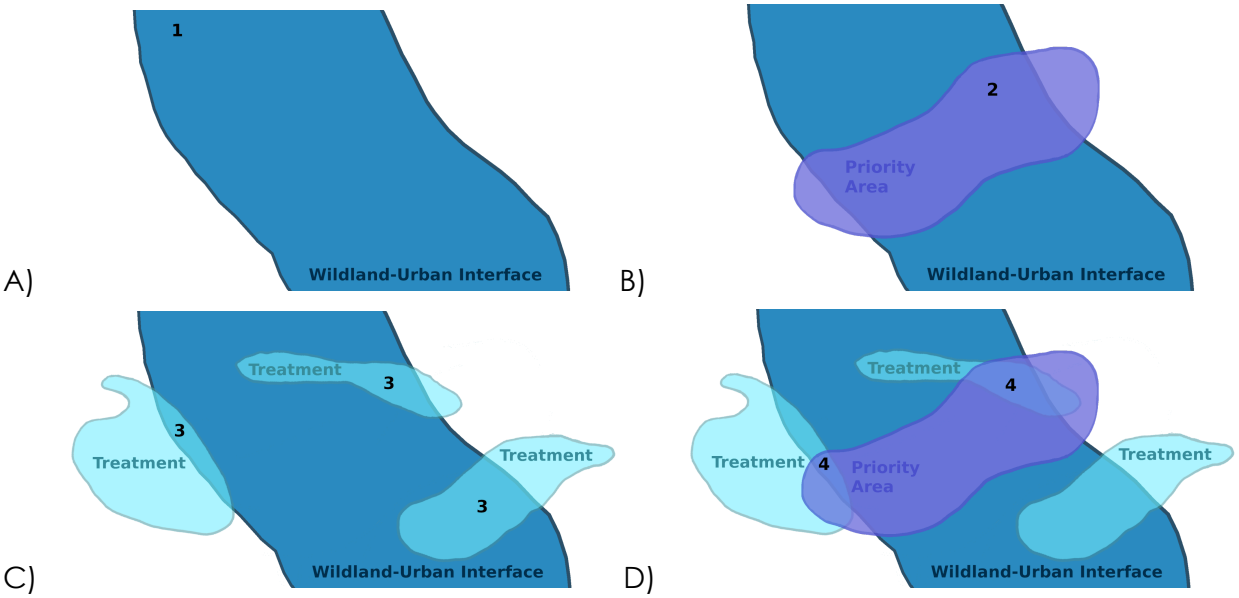
To assess how targeted our effort was, we calculate what proportion of treatments fell into a high priority area for a given policy objective. Note that we can also do the reverse - report on the proportion of the high priority landscape area that is treated - but for any shorter time period (e.g. 1-5 years), that is likely to be a small amount due to the size of the state of California and the area of land in need of treatment. Ideally over a longer time period this proportion will be noticeable. Calculating the proportion of high priority area treated per year may also be useful for planning purposes, helping to indicate how many years it will take to treat priority areas at the current rate of treatment, or the needed rate of treatment to treat all the priority areas in a given timeframe.

All that said, given the timeframe of our reporting, we focus here on the proportion of the treated areas that fell within high priority areas ("4" areas in figure 5). To give context to this proportion, we compare with the proportion of high priority area for the whole landscape. For some policy objectives, high-priority areas may cover a greater or lesser area in general and therefore even if the proportion of high-priority area within treatments seems low, it should be considered in context of how rare that type of area is in the larger landscape. For example, if high wildfire hazard potential areas constitute half of the landscape, and our treatments consist of 75% high wildfire hazard potential areas, even though this is not 100% (meaning a quarter of our treatments are not in high priority areas), it is a higher proportion than the overall amount of high wildfire hazard potential areas on the landscape. We propose a 'targetedness' ratio: the proportion of high priority area in treatments, divided by the proportion of high priority area in the landscape. For our example, this is 0.75/0.50, or 1.5 times as targeted as the background prevalence of the priority area.

To display differences, we share tables summarizing areas, proportions of the area treated, proportions of treated area that were high priority, and the targetedness ratio. We also include bar graphs showing the proportion of treatments that were high priority compared side-by-side with the background proportion of high priority area in the larger landscape. Highly targeted treatments will have a much larger proportion than the background area.

Note that the Interagency Treatment Tracking system does not include information on the project's intended objective, and project managers were not necessarily using the priority layers we are using for evaluating 'targetedness.' Therefore our filters for treatment type relative to policy objective are approximations and the results are aggregated to consider the suite of treatments that were done in the last 4-5 years to see whether they matched priority areas in retrospect. In addition, there was not an overarching policy in place or inter-agency coordination that would cause all entities to use the same metrics to prioritize the same areas. The Task Force has worked to create this kind of coordination, but in the last five years agencies and other entities were not yet operating under the same prioritization schemes. The results therefore also represent an ensemble or collective retrospective on how coordinated the work was even without specific, agreed-upon priority layers.

Figure 5: Spatial relationships between geographical subsets, priority areas, and treatments for calculating targeted effort outcome measurements. First calculate what proportion of an area of interest (shown: Wildland-Urban Interface) is high-priority - for example, Wildfire Hazard Potential rating "High" or "Very High" by dividing the area of overlap in B), labeled '2', by the entire area in A), labeled '1'. Then compare this proportion with the same proportion but only within treated areas: divide the area of overlap between treatments and priority area within the WUI, '4' in D), by the area of treatment within the WUI (labeled '3' in C).



Results of Targeted Effort calculations

Statewide, for each of the priority topics, treatments are implemented less than 50% of the time on priority acres[16] but treatments that could impact policy objectives are typically implemented more often on key acres than the background proportion of those priorities across landscapes (Table 4,Figure 6).

Treatments likely to prioritize lowering wildfire risk are more targeted to high wildfire hazard potential areas than the background proportion in the landscape. Treatments in

[16] The Public Policy Institute of California did a similar calculation for priority areas, but included a 1-km buffer around the treatment polygons, so their proportion that was high priority was higher. https://www.ppic.org/publication/tracking-headwaters-management-for-wildfire-resilience-in-california/

and around utility corridors are nearly 3 times more preferentially targeted than the background prevalence of high wildfire hazard potential in those areas.

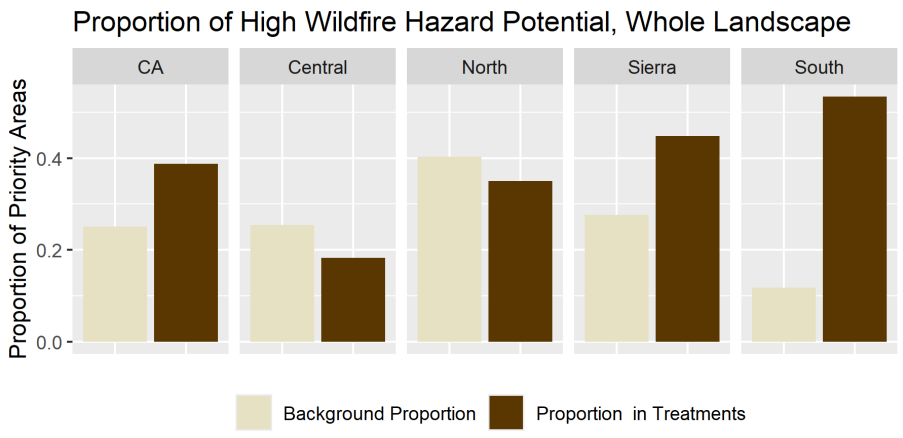
The treatments that could contribute to forest health were not as targeted as those intended for wildfire risk reduction; however, treatments in shrubland were more concentrated near roads.

The treatments may not have been prioritized for improving habitat or water resources, but these co-benefits were also more targeted than the background proportion of high-priority areas – particularly for water-related metrics.

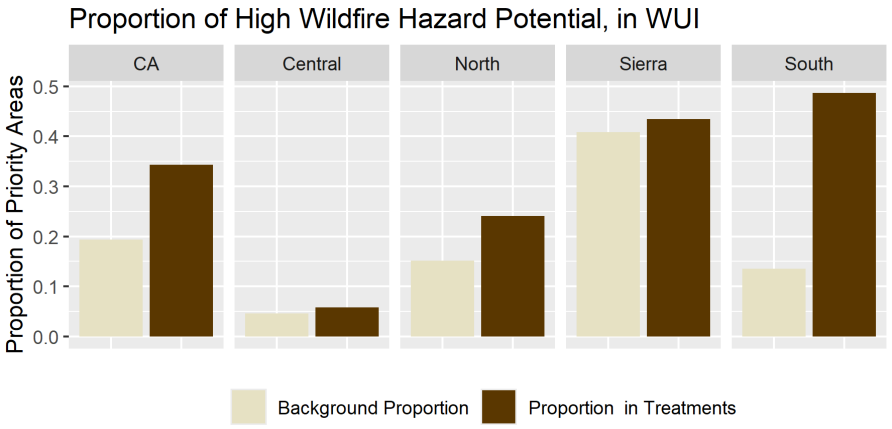
Patterns differed regionally (see Appendix D for the Task Force regions as they were defined at the time of analysis, and see Appendix E for regional summaries).

Figure 6: Targeted effort Background and Treatment Area proportions for A) WHP in the whole landscape, B) WHP in the WUI, C) WHP in road corridors, D), WHP in utility corridors, E) Debris flow, F) Hydropower watersheds, G) important habitat, H) Drought-vulnerable forests, and I) Shrubs near roads.

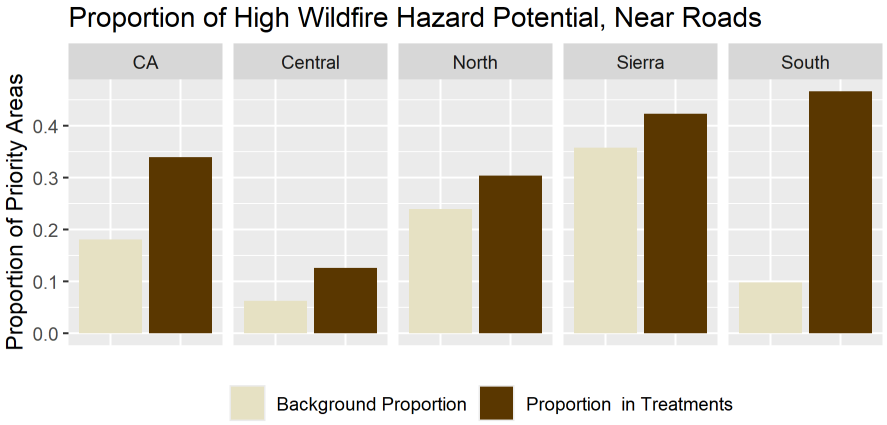
A)



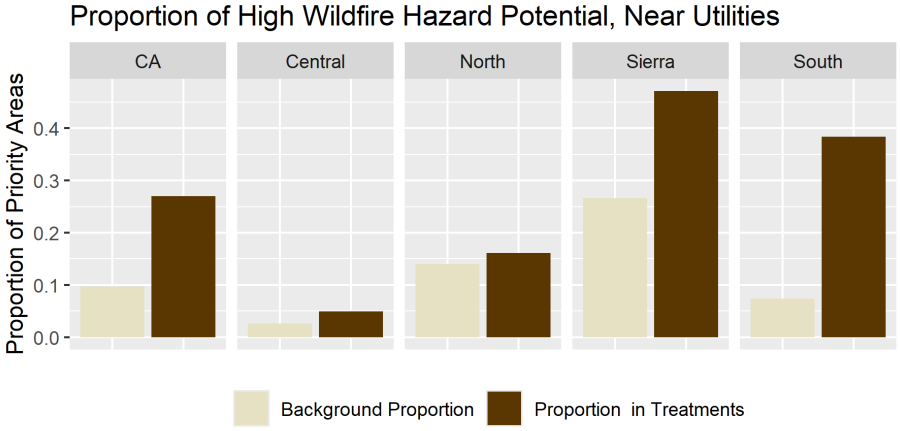
B)


Proportion of High Wildfire Hazard Potential, in WUI
CA
Central
North
Sierra
South
Proportion of Priority Areas
0.0
0.1
0.2
0.3
0.4
0.5
Background Proportion
Proportion in Treatments

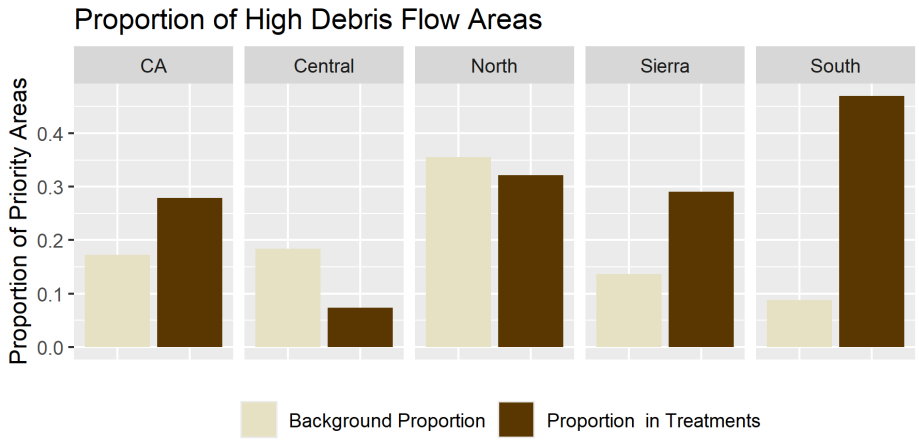
C)


Proportion of High Wildfire Hazard Potential, Near Roads
CA
Central
North
Sierra
South
Proportion of Priority Areas
0.0
0.1
0.2
0.3
0.4
Background Proportion
Proportion in Treatments

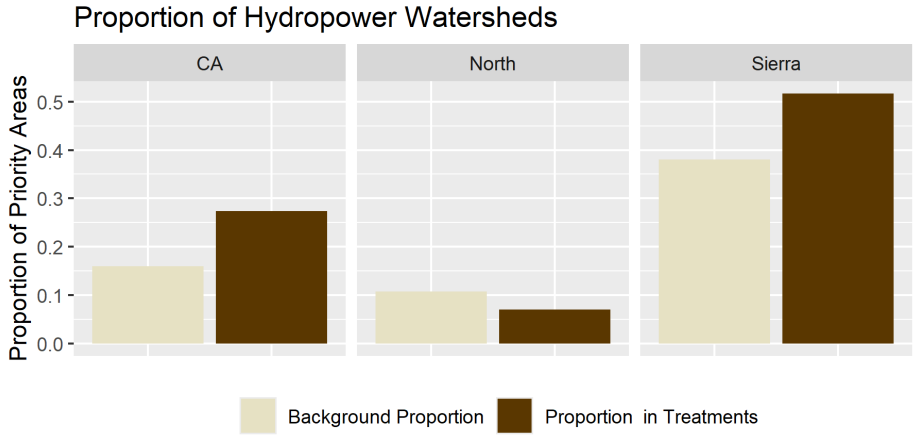
D)


Proportion of High Wildfire Hazard Potential, Near Utilities
CA
Central
North
Sierra
South
Proportion of Priority Areas
0.0
0.1
0.2
0.3
0.4
Background Proportion
Proportion in Treatments

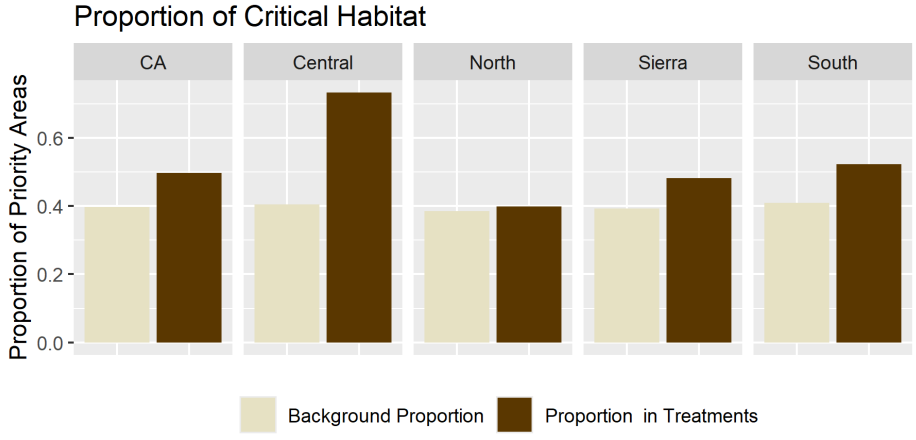
E)


Proportion of High Debris Flow Areas
CA
Central
North
Sierra
South
Proportion of Priority Areas
0.0
0.1
0.2
0.3
0.4
Background Proportion
Proportion in Treatments

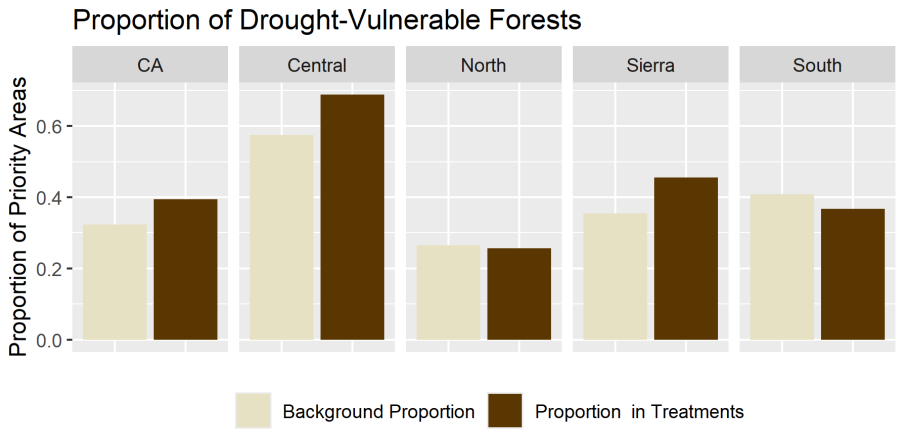
F)


Proportion of Hydropower Watersheds
CA
North
Sierra
Proportion of Priority Areas
0.0
0.1
0.2
0.3
0.4
0.5
Background Proportion
Proportion in Treatments

G)


Proportion of Critical Habitat
CA
Central
North
Sierra
South
Proportion of Priority Areas
0.0
0.2
0.4
0.6
Background Proportion
Proportion in Treatments

H)



I)

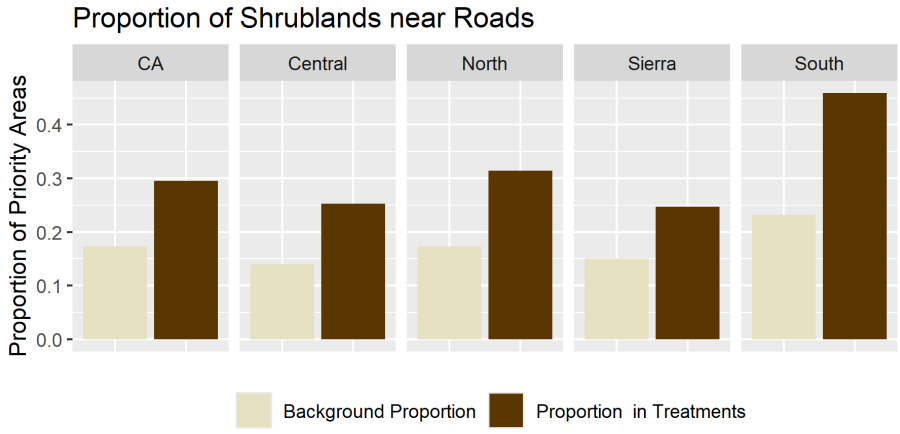


Table 4: Summary table of targeted effort for treatments **statewide** since October 2020. Note that the acres of treatment here are less than the total acres of possible treatment in Table 1 because they have been subset for appropriate areas, e.g. shrubland, forestland, WUI, Wildland (see Table 3 for subsets; in the table, the spatial subset is indicated in parentheses following the metric name). The areas are also smaller than those numbers in Table 2 because these are the areas where treatments were done. Note that there are small differences in the acres calculated for wildfire hazard potential versus Flame Length due to differences in coordinate reference systems.

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Wildfire Hazard Potential (Landscape)	84,411,360	21,154,223	0.25	***1,052,701***	407,656	0.39	***1.5***
Flame Length Above 8 Ft (Landscape)	84,411,507	22,589,720	0.27	***1,052,614***	455,817	0.43	***1.6***
Wildfire Hazard Potential (WUI)	4,752,168	921,240	0.19	***108,004***	37,043	0.34	***1.8***
Flame Length Above 8 Ft (WUI)	4,752,203	1,243,441	0.26	***107,922***	48,812	0.45	***1.7***
Wildfire Hazard Potential (Roads)	23,896,495	4,311,640	0.18	***448,201***	152,157	0.34	***1.9***
Flame Length Above 8 Ft (Roads)	23,896,860	5,123,337	0.21	***448,172***	187,143	0.42	***1.9***
Wildfire Hazard Potential (Utilities)	5,037,412	485,968	0.10	***58,463***	15,775	0.27	***2.8***
Flame Length	5,036,820	608,880	0.12	***58,476***	21,118	0.36	***3.0***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Above 8 Ft (Utilities)							
Drought Vulnerability (Forestland)	22,866,939	7,387,445	0.32	***555,601***	219,415	0.39	***1.2***
Wildfire Hazard Potential (Forestland)	22,866,765	10,699,667	0.47	***498,834***	234,154	0.47	***1.0***
Shrub Vulnerability (Shrubland)	13,326,880	2,310,023	0.17	***172,966***	51,045	0.30	***1.7***
Wildfire Hazard Potential (Shrubland)	13,326,880	5,623,449	0.42	***179,118***	78,342	0.44	***1.0***
Wildfire Hazard Potential (Woodland)	9,258,109	3,602,084	0.39	***159,744***	62,386	0.39	***1.0***
Wildfire Hazard Potential (Grassland)	11,545,358	1,014,019	0.09	***177,162***	28,105	0.16	***1.8***
Debris Flow (Landscape)	84,411,360	14,535,820	0.17	***845,582***	236,004	0.28	***1.6***
Hydropower (Landscape)	84,411,360	13,470,944	0.16	***845,582***	231,553	0.27	***1.7***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Critical Habitat (Landscape)	84,411,360	33,565,935	0.40	***957,749***	476,560	0.50	***1.3***

(2) Efficacy

Methods of Efficacy Calculations

For efficacy calculations, we now focus on not just where the work was done, but what was done and what its potential impacts could be. In this pilot analysis, we were able to do this for the policy objectives of wildfire risk and vegetation health. The steps we used are the following:

1. **Filter treatments for Policy Objective:** As with targeted effort, treatments may not have been intended to or may not be expected to affect a certain policy objective. We approximate the potential objective based on the treatment type.
   e.g. thinning and other mechanical treatments as well as prescribed fire may impact fire hazard/potential risk
2. **Identify Efficacy Metric**: The metric must be calculated the same way before and after treatments, and may be the same metric used for effort or effectiveness.
   e.g. CECS layers for flame length, drought vulnerability, or cover type
3. **Threshold Metric for 'undesired' state:** The threshold is chosen for an undesirable state to be marked '1' and a desirable state to be marked '0' (which may or may not be the same as the priority area threshold used for targeted effort).
   e.g. for reducing wildfire risk, Flame Length greater than 8 feet = 'undesirable'

4. **Geographically subset metric as appropriate**: As in targeted effort, some policy objectives and their associated metrics may only be appropriate for a given ecosystem or management context.
   e.g. for reduced vegetation stress, subset Drought Vulnerability only for WHR Forest Type
5. **Calculate Proportion in "undesirable" state**: For the metric as measured before the treatments, calculate the proportion in the 'undesirable state;' do the same for the metric as measured after the treatments.
   e.g. Grass proportion in shrubland above 50%
6. **Subtract the proportion before and after treatments for**: (a) the whole landscape, to show what the impact of treatments is in context of the larger system, (b) fire footprint, to give context to the impact of treatments because fire often has large impacts which are well understood and can be used as a benchmark, and (c) treatment areas.
   e.g. Statewide, within Treatments, 0.48 of Flame Length in the WUI was above 8 ft in fall 2020, and it was 0.44 in fall 2024.
7. **Reporting options**: Calculate (a) Absolute difference in proportion (simple subtraction of after minus before), and (b) Relative/percent difference (dividing the difference by the starting value to give context to the magnitude of the change)
   e.g. 0.04 absolute reduction in proportion flame length above 8 ft within treatments, corresponding to a 10% decrease relative to the starting value

We elaborate on each step and discuss our implementation of them, below.

Filter treatments for Policy Objective

We used the same treatment filters (choosing treatments that are related to the policy goals of reducing wildfire risk and reducing vegetation stress) as we did for targeted effort. This makes synthesis of the results easier. We then aggregated all filtered treatments done during the water year corresponding to the CECS metrics in question, producing a footprint layer of completed/implemented treatments. Recall that due to the shorter timeframe of our analysis, we have aggregated the treatment footprints for all four years together, rather than reporting year-to-year trends. See above for details on those filtering and subsetting steps. Also note that the Interagency Treatment Tracker does not record whether the project has multiple stages and additional work on that

acre is still planned but not yet completed, so a project footprint may not appear effective but this may be because additional steps remain to be implemented.

Because treatment and fire footprints overlap, we needed a rule for how to handle this when calculating effectiveness. For this pilot analysis, we chose to remove any areas within treatment footprints that overlapped with fire footprints from the same time period, in order to focus on the potential impacts of treatments, because wildfire often had a dominant impact when it burned through a treated area.[17]

Note that because we are relying on remote sensing for our efficacy calculations, treatments that show canopy-level effects visible from the air or from space will have the clearest potential impact. In addition, some data in agency reporting of treatments may reflect planned project areas rather than specifically-treated areas, so ways to filter the 'treated' area to only consider areas that are visibly disturbed in remotely-sensed imagery may be a better way to get a sense of treatment impact rather than using the entire reported footprint. At the end of the efficacy section, we demonstrate this method of using an additional geographical filter to examine only remote sensing-detected canopy disturbed areas (we also use the same filtering on the equivalent fire footprints to maintain comparability).[18]

Identify efficacy metrics

Some metrics used for identifying priority areas in targeted effort analyses may be re-used for efficacy calculations if their values are reasonably calibrated with ground based measurements and there are consistent measurements before and after treatments. Of the data layers we have available, only CECS meets our criteria for an efficacy outcome reporting metric. In particular, CECS data products were designed for spatial accuracy and the metrics are calculated in the same way before and after treatments, in order to make exactly these kinds of before-and-after comparisons. We

[17] Assessed visually for several cases, not exhaustively or quantitatively. In future work in order to calculate effectiveness (rather than efficacy) of treatments, this very intersection between fires and treatments would be the way to test the effects of treatments directly. For efficacy, we keep them separated for clarity of interpretation.

[18] Note that we implemented this in a similar way as the geographic subsetting, using a raster layer to mask out 'unchanged' pixels, but we include this description in the treatment filtering step because conceptually it is about filtering treatments to the areas we want to assess changes in.

also note that the CECS layers are largely calculated according to a water year,[19] which means our treatment footprints are aggregated for a water year rather than a calendar year, to match the data layers. See Appendix B for further information on the CECS layers used in this report.

CECS is, however, a pixel-based set of calculations that does not reflect the effects of neighboring pixels or landscape dynamics. We therefore characterize this calculation as 'basic' efficacy rather than 'advanced' but note that many of these calculations could also be performed on metrics with dynamics or neighborhood effects as well. Further development may be needed for advanced efficacy calculations in order to account for the effects of treatments on their neighbors via spatial windows or other methods.

Threshold Metric for 'undesired' state:

We use the same thresholds as in the targeted effort calculations - i.e. for our metrics, an area that was high priority in late 2020 is also in an 'undesired' state. (These two calculations may differ for other analyses, but for simplicity and interpretability we align our effort and efficacy thresholds.) We then also calculate the proportion of the landscape that is in an undesired state in late 2024 in order to see whether there is a change in the potential area that is unhealthy or at risk. This differs from targeted effort in that we are comparing 'before' and 'after' for treated areas and also for wildfire footprints, and we are comparing the amount of area in the undesirable state, and how much it has changed.

For Wildfire Risk, we used CECS flame length above 8 feet to indicate fire that is typically hard to control and/or is likely to result in high severity impacts. For efficacy assessment, we assigned a pixel a '1' if the flame length was at or above 8 feet, and a '0' if it was below 8 feet. Because this criterion is appropriate specifically for forest, we also applied the forest mask to these calculations, removing anything that was not forest. We also calculated a 'beneficial fire' metric in which we assigned a pixel a '1' if the flame length was 4 feet or below, and a '0' otherwise (this metric is the only one that we hope

[19] "U.S.Geological Survey "water year" in reports that deal with surface-water supply is defined as the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1999 is called the "1999" water year." From: https://water.usgs.gov/nwc/explain_data.html

to see an increase in over time; and is also only appropriate for forested areas). These two metrics are generally the inverse of one another, but not perfectly so.

For Forest Health we used CECS drought vulnerability, thresholded to be equivalent to the 'Imminent Mortality' in Relative Maximum Stand Density Index (calculated by quantile matching; this is the same layer as for Targeted Effort - see Table 2 and Figure 3). We spatially subset for WHR forest pixels only (Figure 4).

For Shrub Health, we used the "proportion grass" in CECS' vegetation proportion layers. For any pixel that is classified as 'shrubland' in the WHR layer, if that pixel was grass dominated ("proportion herbaceous" was 50% or above), we assigned that pixel a '1' to indicate undesirability, and '0' if it was less than 50%. We then subset this geographically into areas near roads (same buffer as in the targeted effort calculations, 500 feet on either side of a road centerline) and areas away from roads.

Geographically subset metric as appropriate

For efficacy, we used the same geographical subsets as for targeted effort (see Figure 4), selecting particular management contexts and ecosystems as appropriate. For wildfire risk, we divided the area of CA into several management-related subsets: the entire landscape (other than agriculture, urban areas, and water bodies), the Wildland-Urban Interface (CALFIRE's Intermix and Interface categories), utility corridors (1000 ft on either side of transmission lines managed by PG&E, SCE, and SDGE[20]), and road corridors (500 ft on either side of a road in CALTRANS' Functional Road Classification layer). For beneficial fire, we reported only on the entire (forested) landscape area and not the WUI, road, or utilities subsets. For forest health, we used the WHR Forest mask as above, and for shrub health we similarly used the WHR Shrub mask.

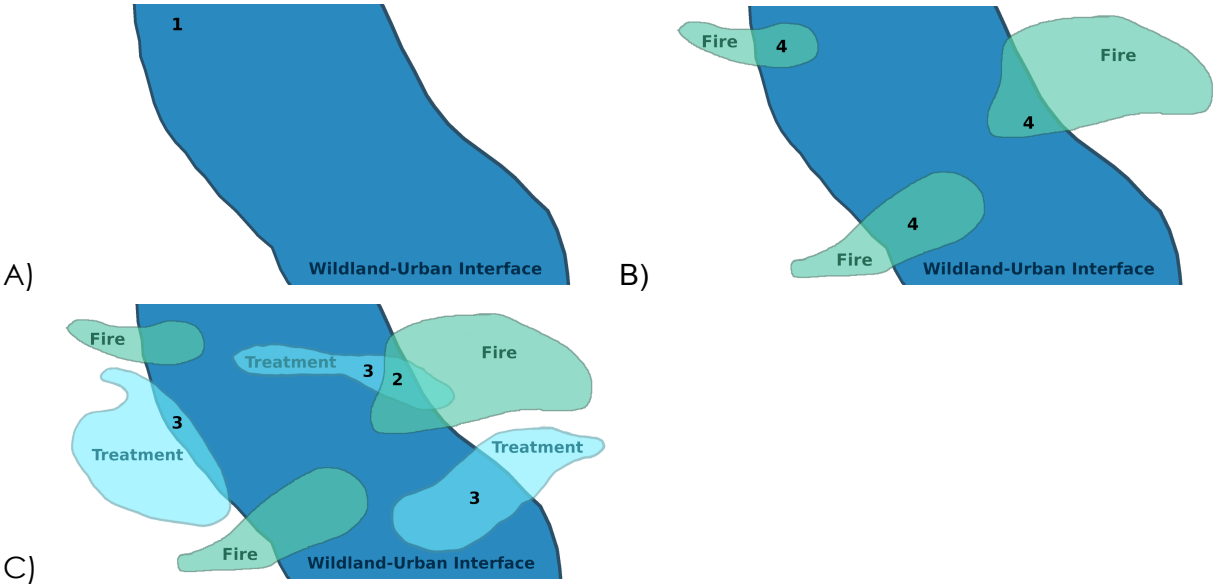
Calculate Proportion in "undesirable" state & subtract the proportion before and after treatments for landscape, fire, and treatment footprints

After filtering the treatments, removing their overlap with wildfires, and aggregating them, and after thresholding the efficacy metric for what we would consider an

[20] Liberty Utilities Corridor Resilience Project Decision Memo, USDA FS LTBMU. 2002. https://usfs-public.app.box.com/v/PinyonPublic/file/935070772254

'undesirable' state, we calculated the proportion in that state within the treatment footprints before they were applied (Figure 7). We then calculated the proportion within treatments that were in the 'undesirable' state after the treatments, and subtracted. We summarize the proportion change for the whole landscape area (within that management context or ecosystem, as appropriate for the metric and policy objective in question), the area within that affected by fires for comparison, and the equivalent treated areas.

Figure 7: Diagram showing how treatments and fires are aggregated within a landscape 'whole area' (here restricted to Wildland-Urban Interface) to get a footprint-style layer to calculate impacts of treatments or fires within a landscape. For example, for the proportion of the area with flame length greater than 8 feet, we calculate the ***A) Whole Landscape***: the proportion for the "larger landscape" (within the WUI, labeled ***'1'***); and then ***B) Fire footprints***: compare that proportion with the proportion 'undesirable' in only the areas that overlap with fires, labeled with ***'4'*** in B); and finally ***C) Treatment areas:*** compare with the proportion 'undesirable' in areas within the WUI that overlap treatments, labeled ***'3'*** in C), but excluding parts of the treatments that also overlap with fires, labeled '2'.



Reporting options

We summarize the results in tables including the areas used for each calculation, the proportion before and after treatments in the 'undesirable' state, the absolute change in proportion, and the relative (percent) change with reference to the initial state

before treatments. For context, we also show the absolute and percent differences for fire footprints (from CALFIRE's fire footprint layer) over the same timeframe and spatial summary area (statewide and for each of the four Task Force Regions, see Appendix D); and we also show the percent differences for the entire landscape (which includes the impacts of treatments and fires as well as other factors like drought mortality, disease or insect outbreaks, and unreported human vegetation management). We include the relevant relative acreage to give context to the differences; see Appendix F for more information about how these areas were calculated.

We define "Minimal change" as < 1% difference; "Modest change" as 1-9% difference; "Moderate change" as 10-25%; difference; and "Meaningful change" as > 25% difference.

Results of Efficacy Calculations

At the statewide level, for reducing possible high-severity fire, over the entire landscape and within the WUI, treatments had a modest impact, and within road and utility corridors, a moderate impact, with fires having a larger impact (Figure 8, Table 5).

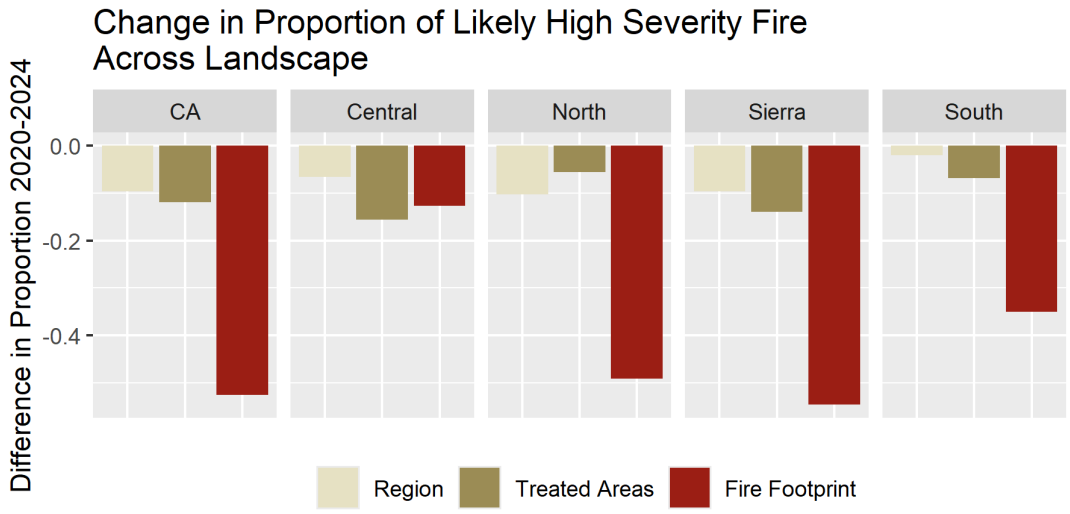
Statewide, within treated areas, potential imminent mortality within forests was meaningfully decreased by treatments, with a larger impact within fire footprints. Within shrublands, treatments showed no change in grass-dominated areas, while fires actually decreased grass-dominance. Beneficial fire (under 4 ft) increased with treatments, but more so with fires.

Note, however, that though fires are more likely to remove sufficient material to reduce potential flame length below 4 feet, this analysis does not evaluate the resulting health and future trajectory of risk in these fire footprints. In addition to negative consequences like debris flows and other issues, the recently burned area may grow back quickly with less desirable, more flammable species, increasing the fire hazard in the short term. Treatments are generally designed with longer-term ecological health and wildfire risk reduction in mind, so it is likely that the long term trajectory of treatment footprints would be to maintain lower potential flame lengths for longer than fire footprints.

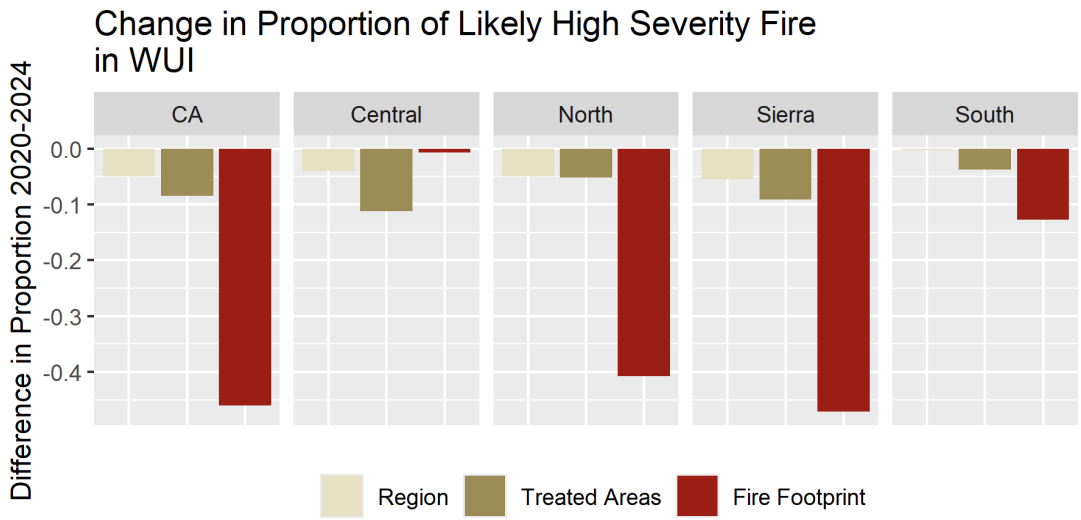
Patterns differed by region (see Appendix G for regional tables).

Figure 8: Results of Efficacy calculations. Changes from October 2020 through September 2024 for the entire region, just treatments within those regions, and just fires within those regions, for A) likely high fire severity across the ***landscape***, B) likely fire severity just within the ***WUI***, C) likely fire severity within and near ***utility*** corridors, D) likely fire severity within ***road*** corridors, E) percent change in grass-dominated shrublands ***outside*** road corridors, F) percent change in grass-dominated shrublands ***inside*** road corridors, G) percent change in potential imminent ***forest mortality*** in forest, and H) potential increase in ***beneficial fire***. Landscape areas include fire and treatment footprints.

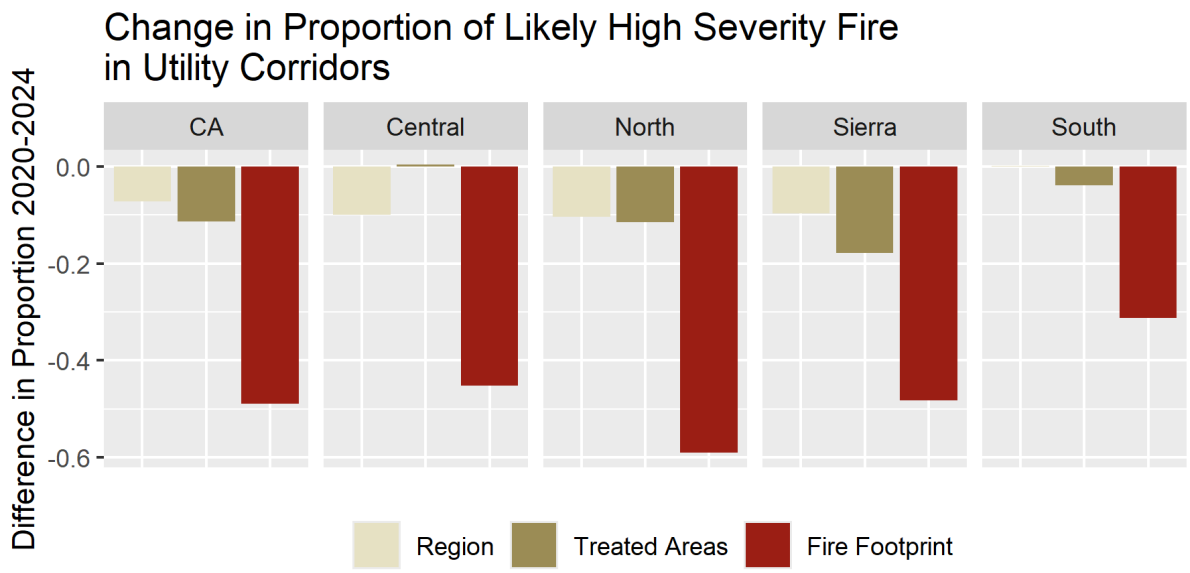
A)



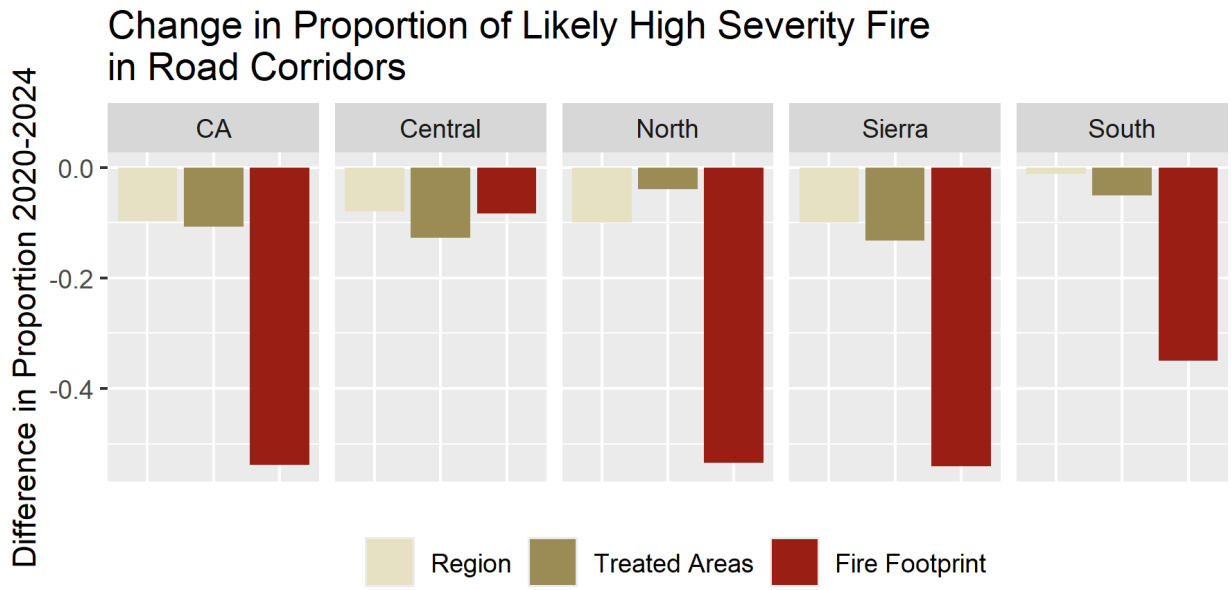
B)



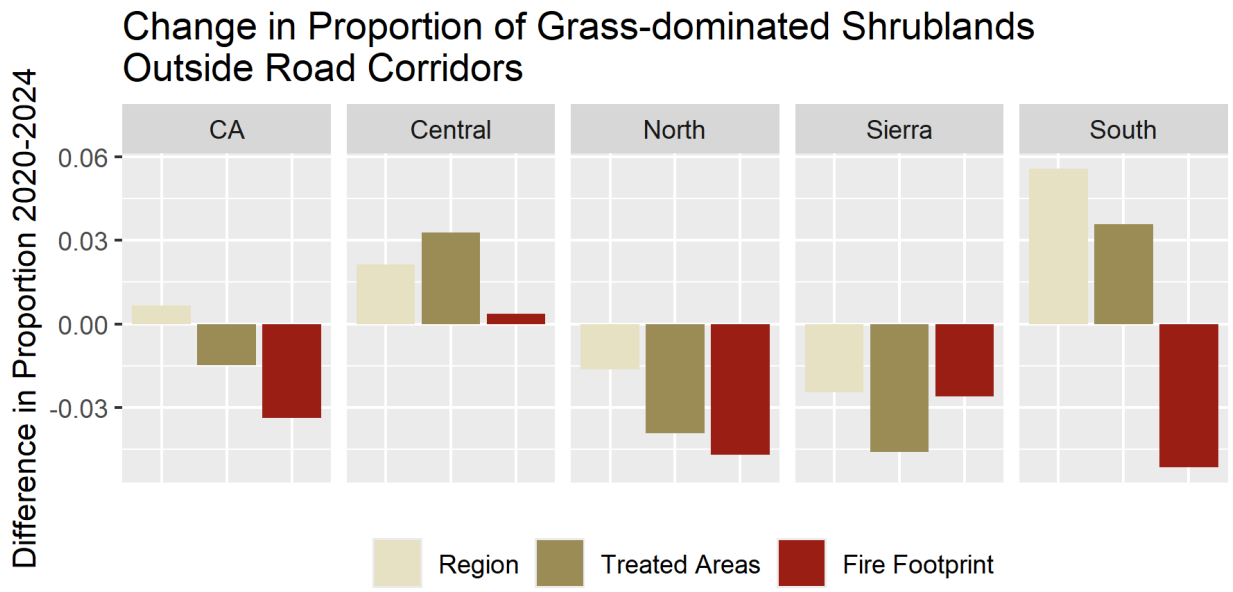
C)


Change in Proportion of Likely High Severity Fire in Utility Corridors
CA
Central
North
Sierra
South
Difference in Proportion 2020-2024
0.0
-0.2
-0.4
-0.6
Region
Treated Areas
Fire Footprint

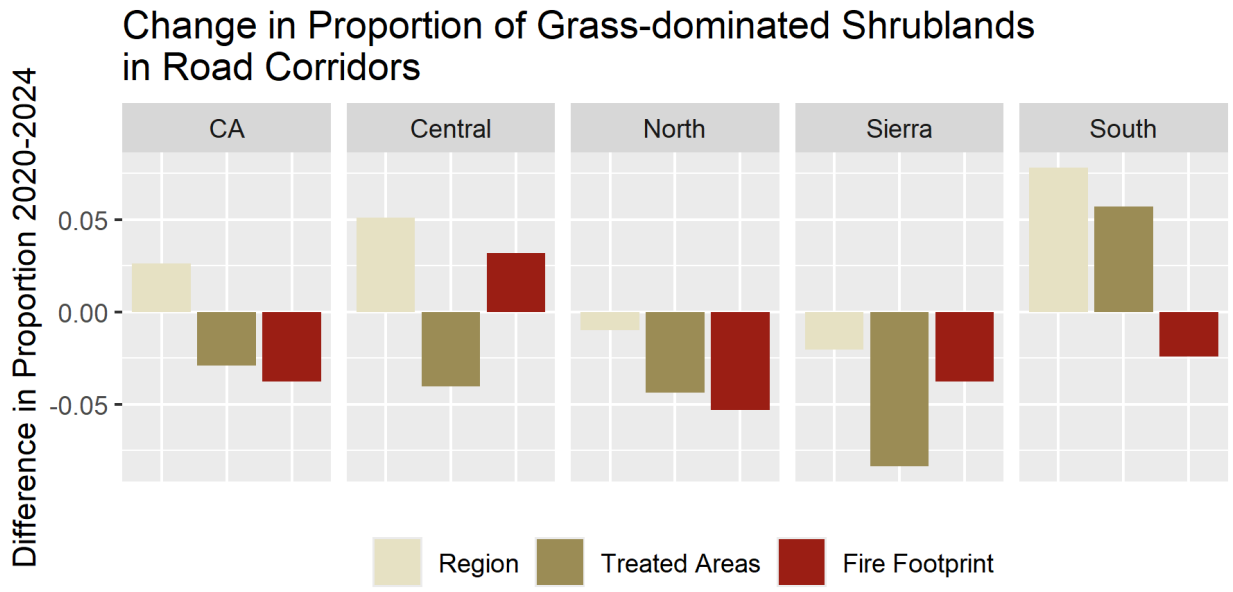
D)


Change in Proportion of Likely High Severity Fire in Road Corridors
CA
Central
North
Sierra
South
Difference in Proportion 2020-2024
0.0
-0.2
-0.4
Region
Treated Areas
Fire Footprint

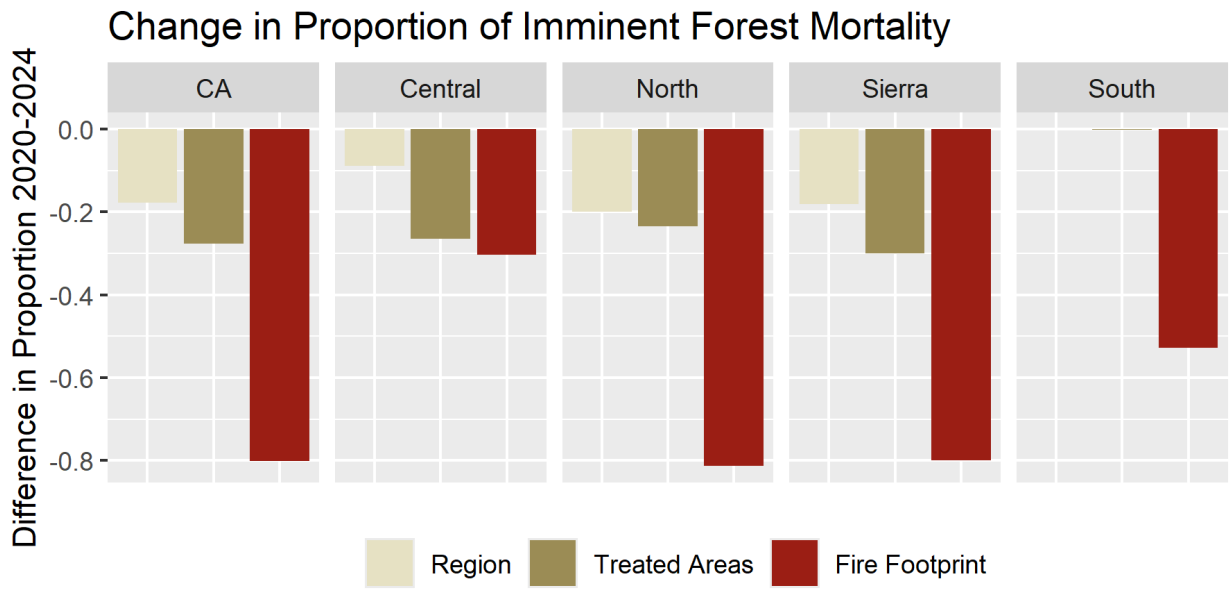
E)


Change in Proportion of Grass-dominated Shrublands
Outside Road Corridors
CA
Central
North
Sierra
South
0.06
0.03
0.00
-0.03
Difference in Proportion 2020-2024
Region
Treated Areas
Fire Footprint

F)


Change in Proportion of Grass-dominated Shrublands
in Road Corridors
CA
Central
North
Sierra
South
0.05
0.00
-0.05
Difference in Proportion 2020-2024
Region
Treated Areas
Fire Footprint

G)



H)

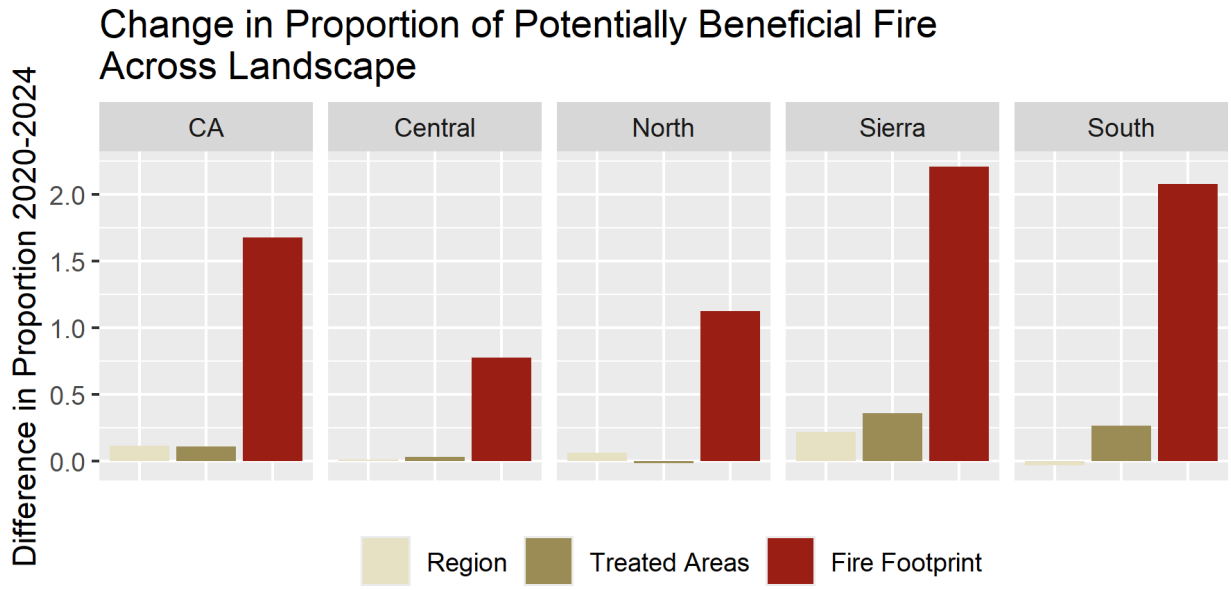


Table 5: Efficacy results for the **entire state**, just treatment footprints throughout the state, and just fire footprints throughout the state (Oct 2020 through September 2024). Note that the treatment acreage given is smaller than for targeted effort, because we are limiting the treatments to be completed before September 30th, 2024, and in targeted effort we use the time range of October 1st 2020 to date. Flame length

calculations are limited to forest areas only. Landscape areas include fire and treatment footprints.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	22,866,117	0.32	0.36	0.04	12%
	Treatments	436,859	0.30	0.33	0.03	11%
	Fires	2,320,872	0.21	0.57	0.36	168%
Flame Length (Forested Landscape)	Landscape	22,866,117	0.52	0.47	-0.05	-10%
	Treatments	436,859	0.52	0.46	-0.06	-12%
	Fires	2,320,872	0.64	0.30	-0.34	-52%
Flame Length (Forested WUI)	Landscape	795,610	0.54	0.52	-0.03	-5%
	Treatments	38,049	0.60	0.55	-0.05	-8%
	Fires	14,610	0.62	0.33	-0.28	-46%
Flame Length (Forested Roads)	Landscape	5,292,474	0.54	0.48	-0.05	-10%
	Treatments	196,538	0.53	0.48	-0.06	-11%
	Fires	465,535	0.62	0.29	-0.33	-54%
Flame Length (Forested Utilities)	Landscape	420,086	0.21	0.20	-0.02	-7%
	Treatments	19,297	0.42	0.37	-0.05	-11%
	Fires	26,067	0.44	0.22	-0.21	-49%
Drought Vulnerability (Forest Health)	Landscape	22,866,117	0.32	0.27	-0.06	-18%
	Treatments	475,291	0.36	0.26	-0.10	-28%
	Fires	2,320,872	0.40	0.08	-0.32	-80%
Grass Proportion Near Roads (Shrubland Health)	Landscape	2,310,385	0.79	0.81	0.02	3%
	Treatments	44,233	0.83	0.80	-0.02	-3%
	Fires	113,057	0.86	0.83	-0.03	-4%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Grass Proportion Away from Roads (Shrubland Health)	Landscape	11,015,164	0.83	0.83	0.01	1%
	Treatments	101,249	0.83	0.82	-0.01	-1%
	Fires	650,920	0.87	0.84	-0.03	-3%

Efficacy for Disturbed areas only

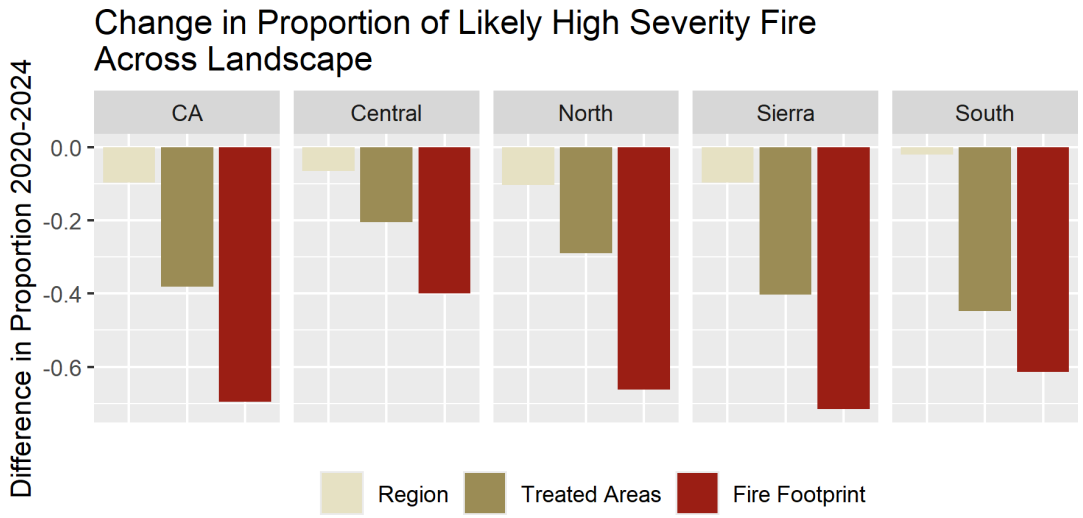
We recognize two important limitations of our efficacy analysis. 1) Because different agencies and entities have different requirements for reporting, some treatment polygons are larger project areas that may include areas that were not actually treated. 2) Many treatments only impact the understory, and the methods we use for the efficacy calculations rely on remote sensing for detection of change so they may only be sensitive to changes in the tree or shrub canopy. There are other limitations (namely that some treatments may show impacts over a longer time period than four years), but to address at least the two limitations listed above, we also calculated efficacy on only areas for which remote sensing can detect a disturbance in tree or shrub canopy.

For this calculation, we used CECS 'disturbance' layers (which are based on the cover type variables previously mentioned[21]), and restricted the 'treatment' and 'fire' footprints to only those pixels within the treatment or fire footprint where there was a change of any kind in tree or shrub cover (for flame length or grassland percentage, respectively) at any time between October 1 2020 and September 30 2024 (the water years associated with these CECS layers). See Figure 9 and Table 6 for the results; see Appendix G for regional tables.

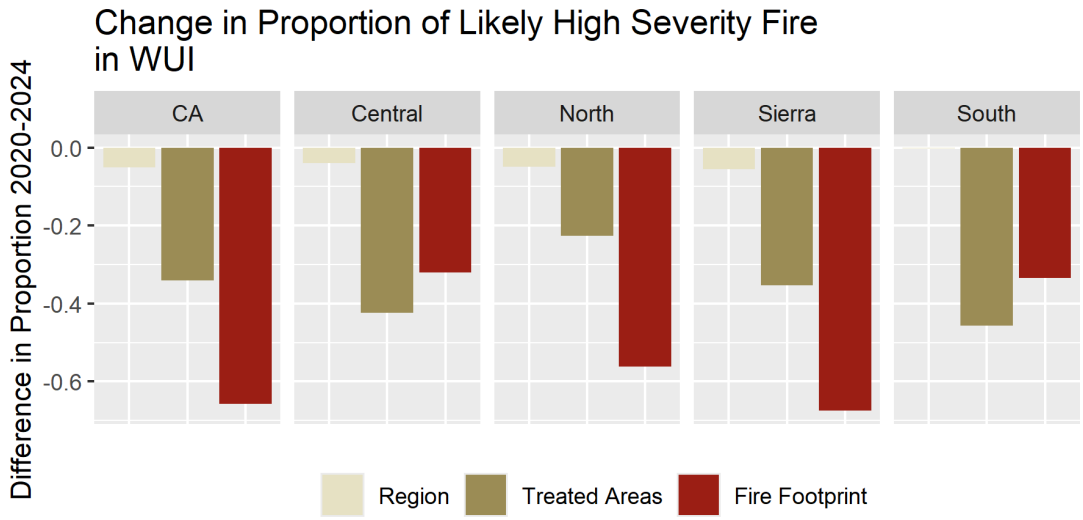
[21] Though the 'disturbance' layers and the flame length and grassland layers are related to each other in that CECS is inherently based on Landsat, the 'disturbance' filter is only a filter to select for places where there was potentially a detectable disturbance; the actual calculations of change require a higher threshold to show a change (e.g. 8 foot flame length or 50% grassland). Also note that we found some image processing artifacts in the version of the shrub disturbance layer that we used, so these results may be less robust than the others (they may include additional pixels where shrub cover did not change, diluting our analysis but not biasing the results). All other CECS layers appeared to be robust.

Figure 9: Results of Efficacy calculations - **for only areas with shrub/tree canopy disturbances as seen in remote sensing**. Changes from October 2020 through September 2024 for the entire region, just treatments within those regions, and just fires within those regions, for A) likely fire severity across the landscape, B) likely fire severity just within the WUI, C) likely fire severity within utility corridors, D) likely fire severity within road corridors, E) percent change in grass-dominated shrublands outside road corridors, F) percent change in grass-dominated shrublands inside road corridors, G) percent change in potential imminent forest mortality in forest, and H) potential increase in beneficial fire. Landscape areas include fire and treatment footprints.

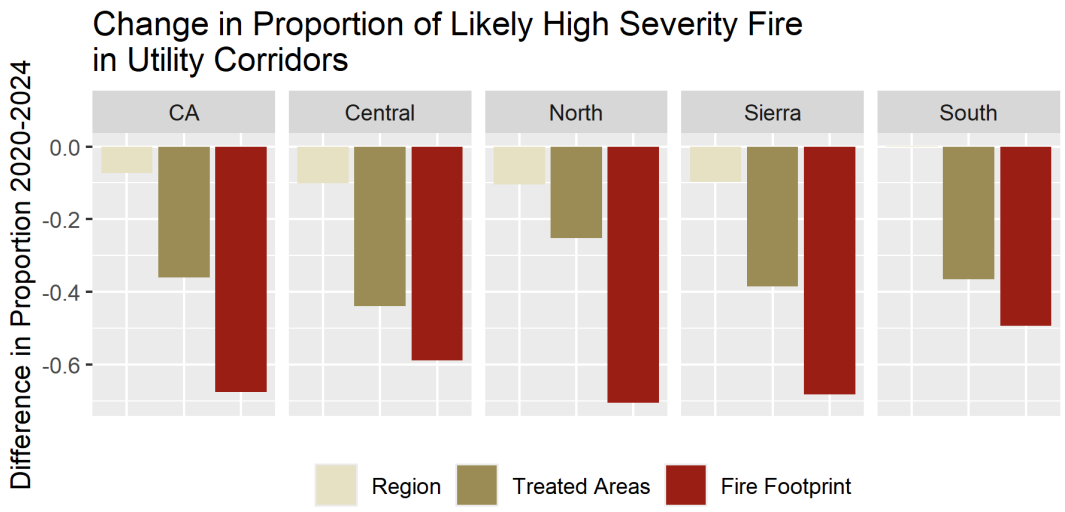
A)



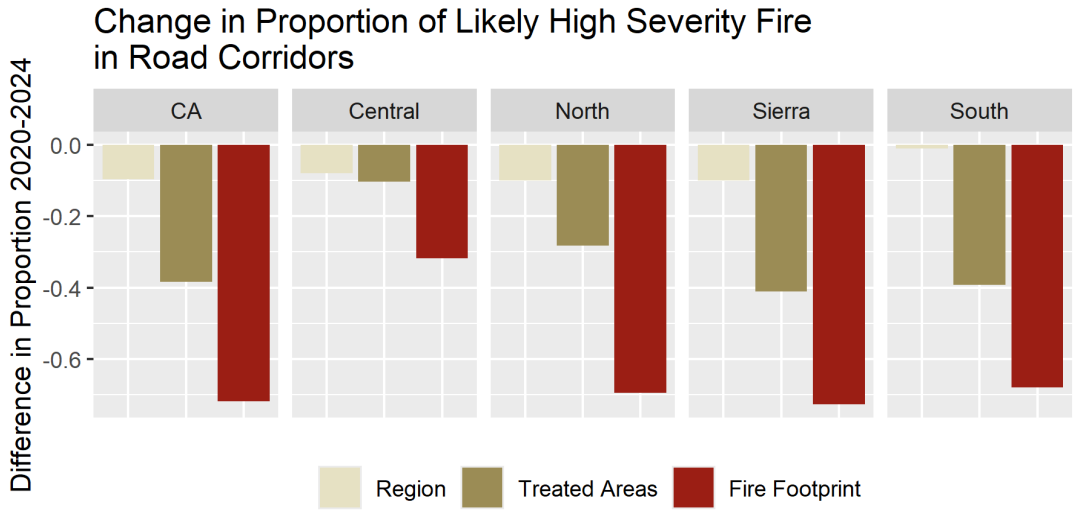
B)

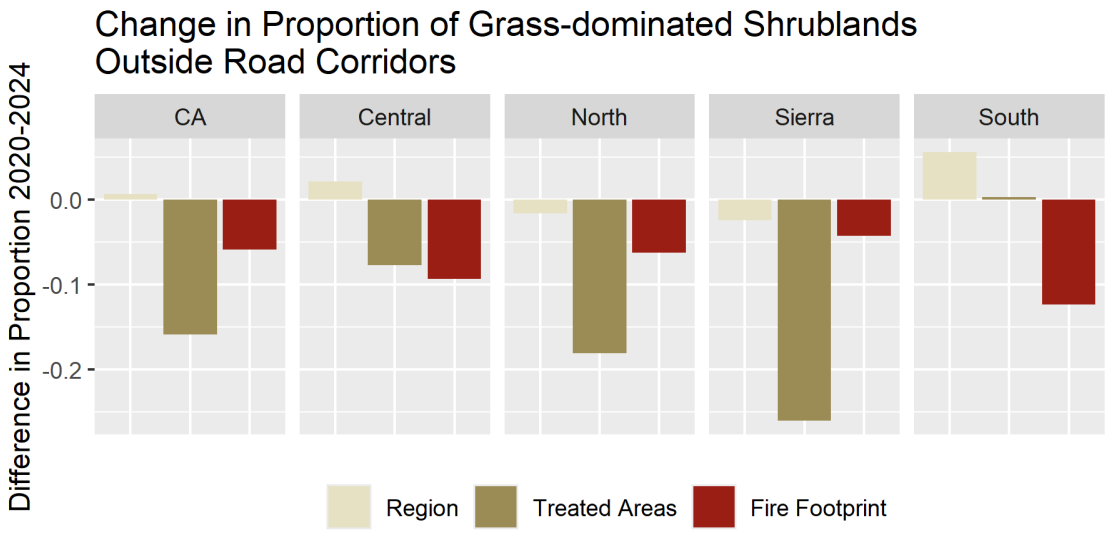


C)

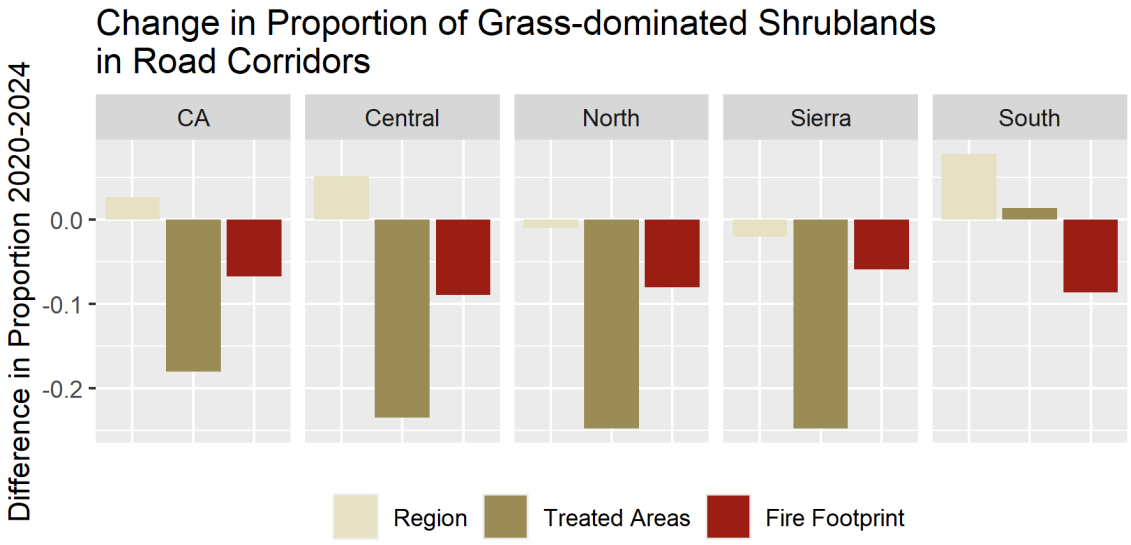

Change in Proportion of Likely High Severity Fire in Utility Corridors
CA
Central
North
Sierra
South
Difference in Proportion 2020-2024
0.0
-0.2
-0.4
-0.6
Region
Treated Areas
Fire Footprint

D)


Change in Proportion of Likely High Severity Fire in Road Corridors
CA
Central
North
Sierra
South
Difference in Proportion 2020-2024
0.0
-0.2
-0.4
-0.6
Region
Treated Areas
Fire Footprint

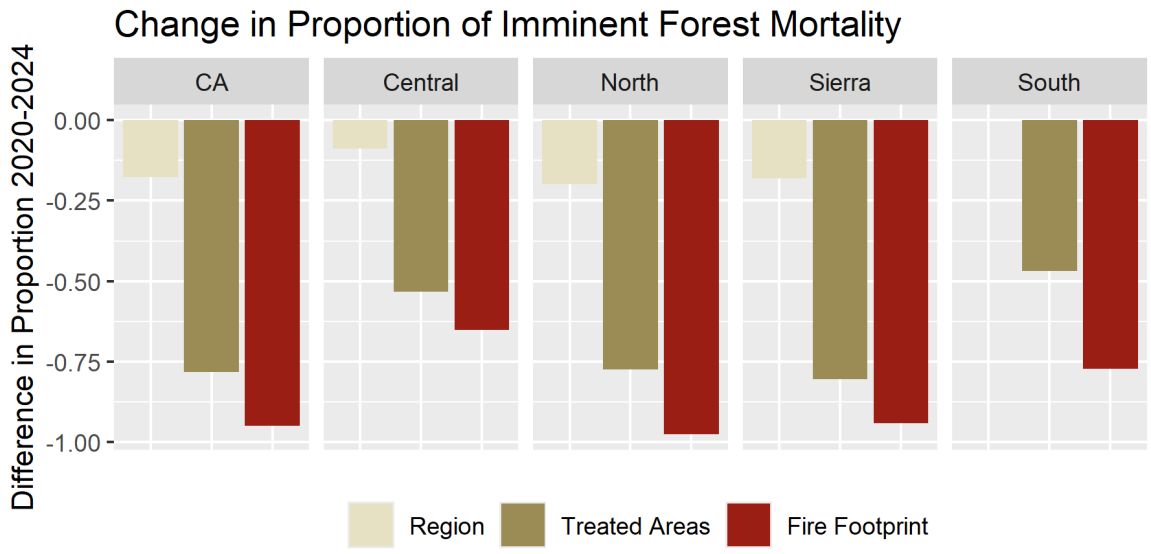

Change in Proportion of Grass-dominated Shrublands
Outside Road Corridors
CA
Central
North
Sierra
South
Difference in Proportion 2020-2024
0.0
-0.1
-0.2
Region
Treated Areas
Fire Footprint

E)


Change in Proportion of Grass-dominated Shrublands
in Road Corridors
CA
Central
North
Sierra
South
Difference in Proportion 2020-2024
0.0
-0.1
-0.2
Region
Treated Areas
Fire Footprint

F)

G)



H)

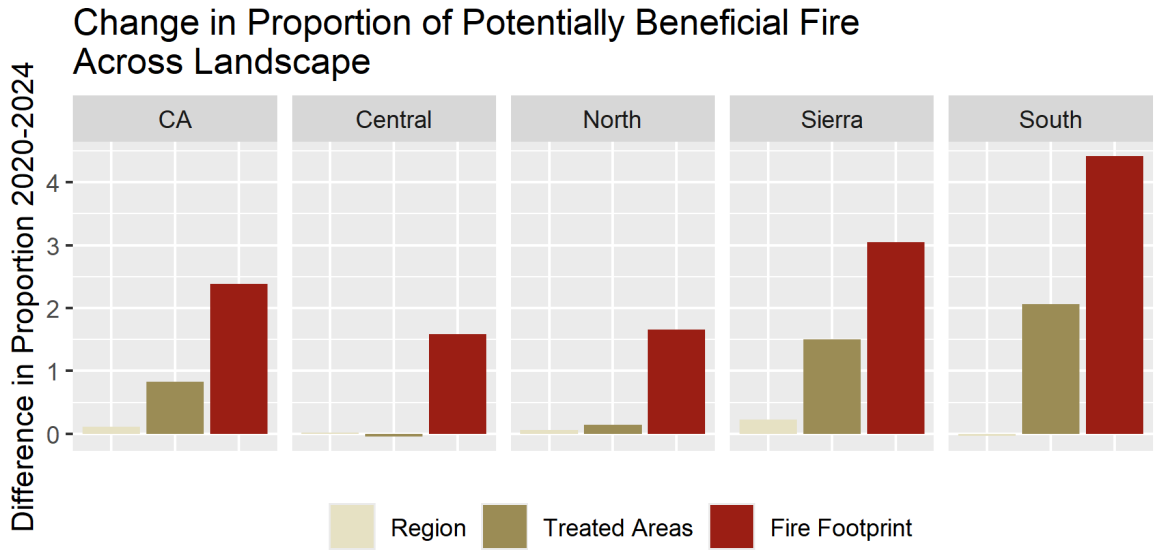


Table 6: Efficacy results for the entire state, only for areas showing tree/shrub canopy disturbance in remote sensing, just treatment footprints throughout the state, and just fire footprints throughout the state (Oct 2020 through September 2024). Note that the treatment acreage given is smaller than for targeted effort, because we are limiting the treatments to be completed before September 30th, 2024, and in targeted effort we use the time range of October 1st 2020 to date. Flame length calculations are limited to

forest areas only. Landscape areas include fire and treatment footprints, and treatment areas reflect the whole footprint as in table 5, not only the visibly disturbed portion.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	22,866,117	0.32	0.36	0.04	12%
	Treatments	436,859	0.19	0.35	0.16	82%
	Fires	2,320,872	0.20	0.68	0.48	238%
Flame Length (Forested Landscape)	Landscape	22,866,117	0.52	0.47	-0.05	-10%
	Treatments	436,859	0.62	0.38	-0.24	-38%
	Fires	2,320,872	0.65	0.20	-0.46	-70%
Flame Length (Forested WUI)	Landscape	795,610	0.54	0.52	-0.03	-5%
	Treatments	38,049	0.65	0.43	-0.22	-34%
	Fires	14,610	0.65	0.22	-0.43	-66%
Flame Length (Forested Roads)	Landscape	5,292,474	0.54	0.48	-0.05	-10%
	Treatments	196,538	0.63	0.39	-0.24	-38%
	Fires	465,535	0.64	0.18	-0.46	-72%
Flame Length (Forested Utilities)	Landscape	420,086	0.21	0.20	-0.02	-7%
	Treatments	19,297	0.63	0.41	-0.23	-36%
	Fires	26,067	0.56	0.18	-0.38	-67%
Drought Vulnerability (Forest Health)	Landscape	22,866,117	0.32	0.27	-0.06	-18%
	Treatments	475,291	0.45	0.10	-0.35	-78%
	Fires	2,320,872	0.43	0.02	-0.41	-95%
Grass Proportion Near Roads (Shrubland Health)	Landscape	2,310,385	0.79	0.81	0.02	3%
	Treatments	44,233	0.81	0.67	-0.15	-18%
	Fires	113,057	0.92	0.85	-0.06	-7%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Grass Proportion Away from Roads (Shrubland health)	Landscape	11,015,164	0.83	0.83	0.01	1%
	Treatments	101,249	0.81	0.68	-0.13	-16%
	Fires	650,920	0.92	0.86	-0.05	-6%

Summary of Results by Topic Area

To summarize and synthesize both targeted effort and efficacy calculations, we give narrative statements first and specific numbers following each. We define "Minimal change" as < 1% difference; "Modest change" as 1-9% difference; "Moderate change" as 10-25%; difference; and "Meaningful change" as > 25% difference. Note that we did not address air, carbon, recreation, local economies, cultural resources, or vulnerable communities due to lack of specific data on these topics suitable for the different levels of outcome reporting. This analysis uses the Interagency Treatment Tracker data from Fall 2025 ("Version 2.0") - which includes treatments through the end of calendar year 2024. For some of our metrics, the 'water year' was used, so we often refer to 'fall 2020 through fall 2024' to refer to the measured impacts of treatments done largely in 2021-2024.

Topic Area 1: Vegetation Health

Forestland:

Treatments that could affect forest health were not particularly targeted towards drought-vulnerable forests, but between late 2020 and late 2024, the treated areas had a meaningful reduction in drought-vulnerability.

- *Proportion of treatments in drought-vulnerable forest areas: 1.2x background proportion of drought-vulnerable areas in forests statewide*
- *Drought-Vulnerability: decrease of 28% statewide within treatments, relative to a reduction of 80% by fires. When considering only areas visibly disturbed in remote sensing imagery, 78% reduction within treatments and 95% within fires.*

Shrubland:

Between late 2020 and late 2024, treatments have not increased grass-dominated shrublands; and, since late 2020, treatments have especially targeted roadside areas within shrublands, which may then be mowed to reduce ignition potential.

- *Proportion of shrubs treated near roads: 1.7x background proportion of roadside shrubs statewide*
- *Majority-Grass in Shrubland near roads: reduction of 3% statewide, relative to a reduction of 4% by fires (which may encourage shrub resprouting in the short term). Away from roads: a reduction of 1%, relative to 3% from fires. When considering only areas visibly disturbed in remote sensing imagery, 18% reduction in grass proportion within treatments and 7% from fires (near roads), and 16% reduction in grass proportion within treatments and 6% from fires (away from roads).*

Note that it is difficult to find a metric to reflect shrubland health in the timeframe of our reporting/available data; conversion to grassland due to, for example, too-frequent fires, may take longer than four years.

Topic Area 2: Wildfire Risk

Statewide, potentially beneficial fire increased inside treatments, but not as much as within fire footprints.

- *Flame lengths below 4 ft: increased by 11% inside treatment areas, compared with 168% inside fire footprints. When considering only areas visibly disturbed in remote sensing imagery, 82% increased inside treatment areas, and 238% inside fire areas.*

<u>Hazard to Communities:</u>

Treatments within the WUI were done in high fire risk areas more often than there is high fire risk throughout the WUI, and treatments modestly reduced potential high severity fire.

- *Proportion of treatments in WUI in high fire hazard areas: 1.7x background proportion*
- *Flame length above 8 ft: reduced by 8% within treatments in the WUI, statewide, relative to 46% by fires. When considering only areas visibly disturbed in remote sensing imagery, 34% reduction within treatments, and 66% within fire footprints.*

<u>Hazard to Utilities:</u>

In utility corridors, treatments were very targeted to high wildfire hazard areas, and achieved a moderate potential reduction in high severity fire.

- *Proportion of treatments in utility corridors with high fire hazard: 2.9x the background proportion of high fire hazard areas in utility corridors*
- *Flame length above 8 ft within utility corridors, statewide: reduced 11% relative to 49% by fires. When considering only areas visibly disturbed in remote sensing imagery, 36% reduction within treatments and 67% reduction within fire footprints*

Hazard to Roads:

In roadside corridors, treatments were targeted towards high risk areas, and also had moderate reductions in potential high severity fire.

- *Proportion of treatments in road corridors with high fire hazard: 1.9x the background proportion of high fire hazard areas in road corridors*
- *Flame length above 8 ft within road corridors, statewide: reduced 11%, relative to 54% by fires. When considering only areas visibly disturbed in remote sensing imagery, 38% reduction within treatment areas and 72% reduction within fire footprints.*

Topic 3: Conserve Biodiversity

Treatments may not have had explicit management objectives to improve habitat. However, more treatments were placed in high-priority areas for biodiversity conservation/species diversity than the background proportion of these areas on the landscape.

- *Proportion of areas with high species diversity in areas of conservation emphasis: 1.3x background amount of area in that condition statewide*

Topic 4: Enhance Watershed Protection

The treatments may not have been specifically intended to improve water resources, but these co-benefits were more targeted than the background proportions of high-priority areas.

- *Proportion of areas at high risk for post-fire debris flows: 1.6x background amount of area in that condition statewide*
- *Proportion of areas at feeding large hydropower plants: 1.7x background amount of area in that condition statewide*

Appendix A: Associations between treatment types and policy goals

Our team[22] queried the Interagency Treatment Tracker database for treatment types currently included in the dataset, and then associated each treatment in a many-to-many relationship with the policy objectives/topics the treatment might contribute to.

Table A1: Policy goals/topics and treatment types.

Treatment Tracker Activity Type	**How have we reduced Fire Risk?**	**How have we improved Vegetation Health?**		**How have we protected habitat?**	**How have we protected water resources?**
	Wildland Fire Risk	Forest Health	Shrubland Health	Habitat	Water
BIOMASS_REMOVAL	X	X			X
BROADCAST_BURN	X	X	X	X	X
CHAIN_CRUSH			X		
CHIPPING	X				
CLEARCUT					
DISCING			X		
DOZER_LINE	X				
ECO_HAB_RESTORATION		X	X		
EROSION_CONTROL		X			
HABITAT_REVEG		X	X		
HANDLINE	X				
HERBICIDE_APP		X	X	X	
INV_PLANT_REM		X	X	X	

[22] Special thanks to Ashlyn Olah for assistance with this mapping of treatment type to management goal.

Treatment Tracker Activity Type	How have we reduced Fire Risk?	How have we improved Vegetation Health?		How have we protected habitat?	How have we protected water resources?
	Wildland Fire Risk	Forest Health	Shrubland Health	Habitat	Water
OVAL					
LOP_AND_SCAT	X	X	X	X	
MASTICATION	X	X		X	X
MOWING	X	X	X		
NOT_DEFINED					
PEST_CNTRL					
PILE_BURN	X		X	X	X
PILING					
PRESCRB_HERBIVORY	X	X	X		
PRUNING	X	X		X	
ROAD_CLEAR					
SEEDBED_PREP		X	X		
SITE_PREP		X			
SLASH_DISPOSAL	X	X			
TBD					
THIN_MAN	X	X	X	X	X
THIN_MECH	X	X		X	X
TREE_FELL		X	X	X	X
TREE_PLNTING		X			
VARIABLE_RETEN_HARVEST		X		X	

Treatment Tracker Activity Type	How have we reduced Fire Risk?	How have we improved Vegetation Health?		How have we protected habitat?	How have we protected water resources?
	Wildland Fire Risk	Forest Health	Shrubland Health	Habitat	Water
WETLAND_RESTOR					X
YARDING					

Appendix B: Details on CECS metrics used in efficacy calculations

For the methods in this report, especially the efficacy calculations, we rely on the CECS layers, below. CECS is a wall-to-wall[23] dataset calculated the same way for all the years of the LANDSAT archive. The version of the data we used in this outcome reporting pilot was calculated in 2025 and includes years up through 2024.[24]

Proportion Grass (Vegetation Cover Type & Percentage)

The underlying vegetation types are dynamically calculated for each year, using the LANDSAT image stack and COLD[25] algorithm to get reflectance values for a given date/time and specific pixel, correlated with ground-based Fveg data on cover type, size, and density, and is predicted to non-measured years/locations using the RandomForests classification algorithm. These predictive models are trained and tested using static Fveg (for the year it was measured, not necessarily the year attached to a given dataset, because Fveg datasets come from a variety of different years). This

[23] Though these layers only consider the EPA Level IV EcoZones in California that burn frequently (Ecozone 1-6,8,9,78 and 85).
(https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/ca/ca_eco_l4.htm)
Omernik, J. M. & Griffith, G. E. Ecoregions of the Conterminous United States: Evolution of a Hierarchical Spatial Framework. Environmental Management 54, 1249–1266 (2014).
[24] Current, updated versions of these datasets are now found at ForestSignal, found here: https://source.coop/forestsignal
https://radiantearth.github.io/stac-browser/#/external/data.source.coop/forestsignal/forestsignal-ca/catalog.json?.language=en
[25] Continuous monitoring of Land Disturbance (COLD)) from https://github.com/GERSL/COLD
Zhu, Z. et al. Continuous monitoring of land disturbance based on Landsat time series. Remote Sensing of Environment 238, 111116 (2020).

results in a vegetation type, size, and density for all pixels in all years. For the proportion grass, we use the "Herb" layer and threshold it for above or below 50%.

Disturbance layers: Change in shrub cover and change in forest cover

For each year of the archive, based on the above vegetation datasets, CECS includes a disturbance layer for absolute loss of tree or shrub canopy during the calendar year. For this analysis, separately for the forest and shrub cover metrics, we calculated a layer that indicated whether there was any change in that cover over the duration of the treatments, in order to do the efficacy calculation for only areas where disturbances were clearly visible to remote sensing. The shrub layers in the version of CECS we used showed some remote sensing calculation artifacts (Landsat scan line correction errors, tile edge mismatches) but all other layers appeared to be robust. Because the shrub disturbance layer was only used to subset the efficacy analysis, it may have included additional pixels where there was no canopy change and only dilutes the results rather than biasing them.

Flame Length

This metric uses dynamic vegetation information (above) translated into FLAMMAP[26] inputs to generate flame lengths. FlamMap outputs provide a relative indication of fire hazard based on topography and the fuels mapped for a given year; the weather is held constant and these data do not account for year to year or spatial patterns of wind or fuel moisture. The resulting flame lengths were compared with similar layers from Pyrologix for predicted fire severity, and the CAL FIRE Historic Fire Perimeters database[27] and the Monitoring Trends in Burn Severity program (MTBS[28]). These other datasets were used for calibration and iterative development of the CECS Flame Length layer. We thresholded this layer to reflect areas with flame lengths above 8 ft ("potentially high severity") and below 4 ft ("potentially beneficial").

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[26] Finney, M. A. An overview of FlamMap fire modeling capabilities. in *In: Andrews, Patricia L.; Butler, Bret W., comps. 2006. Fuels Management-How to Measure Success: Conference Proceedings. 28-30 March 2006; Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 213-220* vol. 41 (2006).

[27] Fire Perimeters | CAL FIRE. https://www.fire.ca.gov/what-we-do/fire-resource-assessment-program/fire-perimeters.

[28] Eidenshink, J. et al. A Project for Monitoring Trends in Burn Severity. fire ecol 3, 3–21 (2007).

Drought Vulnerability

CECS first calculates Annual (aggregated over the water year) Actual EvapoTranspiration (AET) in mm, and uses flux tower data and RandomForests to project this across the landscape. Potential precipitation in mm during an extreme drought was calculated with PRISM. These were then combined with the percent tree cover from the above vegetation layer, as follows: % tree cover * mm AET / mm P for 48-month SPI = -2

This metric should be thought of as a relative metric of the risk of tree die-off during severe drought - it corresponds to being two standard deviations below normal precipitation ("SPI = -2") for a four year period ("48 month"). The data were compared with actual drought mortality information in the southern Sierra Nevada from a drought in 2012-2014. Finally, we used quantile matching to establish a threshold of the drought vulnerability metric that corresponded to percent of maximum Stand Density Index in the category of "Imminent mortality."

Appendix C: Details on hydropower layer for targeted effort

This layer identifies the primary watershed areas contributing to major hydropower facilities in California, created by Han Guo and Roger Bales as part of a co-benefits analysis for the State. Hydropower plants with installed capacity greater than 30 MW were linked to their associated reservoirs using Federal Energy Regulatory Commission licensing documents. Reservoir-specific contributing watersheds were delineated from flow-direction and flow-accumulation analyses and the National Hydrography Dataset stream network. Watersheds associated with each facility were then merged to represent the upstream contributing area.

Appendix D: Task Force Regions

Figure D1: Map of Task Force Regions as of July 22, 2025.

Appendix E: Regional Tables for Targeted Effort

Table E1: As Table 4, but only for Southern California Region (Note that no hydropower houses above 30 MW were located in this region)

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Wildfire Hazard Potential (Landscape)	25,230,965	2,957,589	0.12	***95,139***	50,816	0.53	***4.6***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Flame Length Above 8 Ft (Landscape)	25,231,243	2,651,287	0.11	***95,102***	44,124	0.46	***4.4***
Wildfire Hazard Potential (WUI)	1,738,581	234,991	0.14	***30,302***	14,753	0.49	***3.6***
Flame Length Above 8 Ft (WUI)	1,738,638	312,200	0.18	***30,256***	13,805	0.46	***2.5***
Wildfire Hazard Potential (Roads)	6,561,504	642,343	0.10	***55,081***	25,688	0.47	***4.8***
Flame Length Above 8 Ft (Roads)	6,560,428	719,441	0.11	***55,046***	23,431	0.43	***3.9***
Wildfire Hazard Potential (Utilities)	1,860,344	136,099	0.07	***9,913***	3,807	0.38	***5.2***
Flame Length Above 8 Ft (Utilities)	1,859,012	163,768	0.09	***9,921***	3,840	0.39	***4.4***
Drought Vulnerability (Forestland)	539,549	220,170	0.41	***12,475***	4,587	0.37	***0.9***
Wildfire Hazard	539,514	414,935	0.77	***11,461***	9,011	0.79	***1.0***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Potential (Forestland)							
Shrub Vulnerability (Shrubland)	3,641,662	843,458	0.23	***29,376***	13,488	0.46	***2.0***
Wildfire Hazard Potential (Shrubland)	3,641,662	2,106,702	0.58	***46,665***	31,502	0.68	***1.2***
Wildfire Hazard Potential (Woodland)	841,194	228,183	0.27	***9,945***	4,715	0.47	***1.7***
Wildfire Hazard Potential (Grassland)	819,763	135,068	0.16	***14,905***	4,002	0.27	***1.6***
Debris Flow (Landscape)	25,230,965	2,219,917	0.09	***59,773***	28,083	0.47	***5.3***
Critical Habitat (Landscape)	25,230,965	10,342,808	0.41	***65,042***	34,005	0.52	***1.3***

Table E2: As Table 4, but only for Northern California Region

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Wildfire Hazard Potential (Landscape)	16,735,486	6,743,972	0.40	***274,428***	95,942	0.35	***0.9***
Flame Length Above 8 Ft (Landscape)	16,735,636	6,975,751	0.42	***274,414***	95,470	0.35	***0.8***
Wildfire Hazard Potential (WUI)	887,407	134,636	0.15	***15,302***	3,677	0.24	***1.6***
Flame Length Above 8 Ft (WUI)	887,244	213,096	0.24	***15,242***	5,566	0.37	***1.5***
Wildfire Hazard Potential (Roads)	5,482,021	1,310,284	0.24	***119,665***	36,348	0.30	***1.3***
Flame Length Above 8 Ft (Roads)	5,482,807	1,538,154	0.28	***119,646***	39,586	0.33	***1.2***
Wildfire Hazard Potential (Utilities)	874,589	122,096	0.14	***16,666***	2,686	0.16	***1.2***
Flame Length	875,127	146,645	0.17	***16,674***	3,720	0.22	***1.3***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Above 8 Ft (Utilities)							
Drought Vulnerability (Forestland)	10,190,530	2,696,798	0.26	***184,972***	47,410	0.26	***1.0***
Wildfire Hazard Potential (Forestland)	10,190,324	4,790,853	0.47	***163,466***	63,599	0.39	***0.8***
Shrub Vulnerability (Shrubland)	2,052,467	355,392	0.17	***27,595***	8,660	0.31	***1.8***
Wildfire Hazard Potential (Shrubland)	2,052,467	990,646	0.48	***29,628***	16,664	0.56	***1.2***
Wildfire Hazard Potential (Woodland)	1,484,118	670,277	0.45	***30,642***	11,707	0.38	***0.8***
Wildfire Hazard Potential (Grassland)	2,595,619	264,129	0.10	***42,240***	3,566	0.08	***0.8***
Debris Flow (Landscape)	16,735,486	5,949,181	0.36	***241,868***	77,708	0.32	***0.9***
Hydropower (Landscape)	16,735,486	1,798,917	0.11	***241,868***	16,923	0.07	***0.7***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Critical Habitat (Landscape)	16,735,486	6,434,400	0.38	***270,892***	107,812	0.40	***1.0***

Table E3: As Table 4, but only for Sierra Nevada Region

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Wildfire Hazard Potential (Landscape)	30,662,796	8,458,593	0.28	***513,421***	229,881	0.45	***1.6***
Flame Length Above 8 Ft (Landscape)	30,663,270	9,651,213	0.31	***513,394***	267,150	0.52	***1.7***
Wildfire Hazard Potential (WUI)	1,251,197	511,411	0.41	***39,836***	17,295	0.43	***1.1***
Flame Length Above 8 Ft (WUI)	1,251,452	578,524	0.46	***39,878***	23,741	0.60	***1.3***
Wildfire Hazard Potential (Roads)	5,497,936	1,963,981	0.36	***187,578***	79,306	0.42	***1.2***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Flame Length Above 8 Ft (Roads)	5,498,884	2,273,338	0.41	***187,635***	105,538	0.56	***1.4***
Wildfire Hazard Potential (Utilities)	702,225	186,945	0.27	***18,282***	8,618	0.47	***1.8***
Flame Length Above 8 Ft (Utilities)	702,601	221,509	0.32	***18,280***	10,376	0.57	***1.8***
Drought Vulnerability (Forestland)	11,408,334	4,051,583	0.36	***338,941***	154,189	0.45	***1.3***
Wildfire Hazard Potential (Forestland)	11,408,148	5,224,353	0.46	***307,695***	158,941	0.52	***1.1***
Shrub Vulnerability (Shrubland)	4,462,505	668,769	0.15	***77,279***	19,113	0.25	***1.7***
Wildfire Hazard Potential (Shrubland)	4,462,505	890,943	0.20	***67,053***	19,389	0.29	***1.4***
Wildfire Hazard Potential (Woodland)	4,589,445	1,911,451	0.42	***69,991***	33,903	0.48	***1.2***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Wildfire Hazard Potential (Grassland)	2,625,983	329,912	0.13	***49,262***	15,067	0.31	***2.4***
Debris Flow (Landscape)	30,662,796	4,194,640	0.14	***415,129***	120,705	0.29	***2.1***
Hydropower (Landscape)	30,662,796	11,672,971	0.38	***415,129***	214,607	0.52	***1.4***
Critical Habitat (Landscape)	30,662,796	12,029,298	0.39	***482,437***	232,599	0.48	***1.2***

Table E4: As Table 4, but only for Central Coast Region. (Note that no hydropower houses above 30 MW were located in this region)

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Wildfire Hazard Potential (Landscape)	11,800,230	2,996,325	0.25	***169,711***	31,020	0.18	***0.7***
Flame Length Above 8 Ft (Landscape)	11,800,298	3,313,878	0.28	***169,701***	49,074	0.29	***1.0***
Wildfire Hazard	876,894	40,287	0.05	***22,564***	1,317	0.06	***1.3***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Potential (WUI)							
Flame Length Above 8 Ft (WUI)	876,799	139,760	0.16	***22,546***	5,700	0.25	***1.6***
Wildfire Hazard Potential (Roads)	6,362,227	395,611	0.06	***85,877***	10,814	0.13	***2.0***
Flame Length Above 8 Ft (Roads)	6,362,162	593,301	0.09	***85,846***	18,588	0.22	***2.3***
Wildfire Hazard Potential (Utilities)	1,598,444	40,862	0.03	***13,601***	665	0.05	***1.9***
Flame Length Above 8 Ft (Utilities)	1,598,294	77,031	0.05	***13,600***	3,182	0.23	***4.9***
Drought Vulnerability (Forestland)	729,945	419,483	0.57	***19,216***	13,230	0.69	***1.2***
Wildfire Hazard Potential (Forestland)	729,966	270,446	0.37	***16,212***	2,604	0.16	***0.4***

Metric	Relevant Landscape Area (Acres)	Total High-Priority Area (Acres)	Background Proportion of High-Priority Area	Policy-Relevant Treatment Area (Acres)	High-Priority Area within Treatments (Acres)	Proportion of High-Priority Areas within Treatments	How Targeted are Treatments
Shrub Vulnerability (Shrubland)	3,170,794	442,790	0.14	***38,716***	9,784	0.25	***1.8***
Wildfire Hazard Potential (Shrubland)	3,170,794	1,635,690	0.52	***35,771***	10,786	0.30	***0.6***
Wildfire Hazard Potential (Woodland)	2,345,655	792,318	0.34	***49,166***	12,060	0.25	***0.7***
Wildfire Hazard Potential (Grassland)	5,515,127	285,026	0.05	***70,754***	5,470	0.08	***1.5***
Debris Flow (Landscape)	11,800,230	2,173,699	0.18	***128,812***	9,510	0.07	***0.4***
Critical Habitat (Landscape)	11,800,230	4,768,313	0.40	***139,378***	102,144	0.73	***1.8***

Appendix F: Calculating areas for each efficacy metric

Table B1: For each of the efficacy metrics, which spatial masks are applied to get each of the treatment areas.

Treatment Mask	Forest	Shrub	Utility	Road	Non-Road	WUI
Flame length > 8	X					

ft (Landscape)						
Flame length > 8 ft (Utilities)	X		X			
Flame length > 8 ft (Roads)	X			X		
Flame length > 8 ft (WUI)	X					X
Flame length < 4 ft (Landscape)	X					
Grass Proportion (Near Roads)		X		X		
Grass Proportion (Not Near Roads)		X			X	
Drought Vulnerability	X					

For "Whole Landscape" calculations and "Fire" calculations, the same filters apply. But the treatment areas were calculated by also excluding any overlap with fire footprints, because it is then unclear whether the treatment or the fire had the impact that we see (and often the fires are the dominant effect, because megafires remove a great deal of material and often treatments are more conservative).

For "disturbance-only" calculations, we only applied these to treatments and to fires, because they are intended to refine the treatment polygons to focus on places where a disturbance was recognized in the remote sensing data. We do the same for fires in order to compare like to like.

Appendix G: Regional Tables for Efficacy

Tables G1-G4 are regional summaries for the entire treatment or fire footprints; Tables G5-G8 are for only the parts of the treatment and fire footprints that are visibly disturbed in remote sensing imagery.

Table G1: Average differences over all of the Southern California region, just treatment footprints throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	539,532	0.16	0.16	-0.01	-3%
	Treatments	9,722	0.08	0.10	0.02	27%
	Fires	3,038	0.10	0.30	0.20	208%
Flame Length (Forested Landscape)	Landscape	539,532	0.62	0.61	-0.01	-2%
	Treatments	9,722	0.68	0.63	-0.05	-7%
	Fires	3,038	0.65	0.42	-0.23	-35%
Flame Length (Forested WUI)	Landscape	41,263	0.64	0.64	0.00	0%
	Treatments	2,482	0.67	0.64	-0.03	-4%
	Fires	26	0.54	0.48	-0.07	-13%
Flame Length (Forested Roads)	Landscape	122,332	0.63	0.62	-0.01	-1%
	Treatments	5,160	0.67	0.64	-0.03	-5%
	Fires	978	0.62	0.40	-0.22	-35%
Flame Length (Forested Utilities)	Landscape	20,616	0.14	0.14	0.00	0%
	Treatments	758	0.44	0.43	-0.02	-4%
	Fires	166	0.22	0.15	-0.07	-31%
Drought Vulnerability (Forest Health)	Landscape	539,532	0.41	0.41	0.00	0%
	Treatments	10,829	0.36	0.36	0.00	0%
	Fires	3,038	0.49	0.23	-0.26	-53%
Grass Proportion Near Roads (Shrubland Health)	Landscape	843,291	0.73	0.78	0.06	8%
	Treatments	11,171	0.82	0.87	0.05	6%
	Fires	19,703	0.65	0.63	-0.02	-2%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Grass Proportion Away from Roads (Shrubland Health)	Landscape	2,797,628	0.80	0.85	0.04	6%
	Treatments	10,796	0.81	0.84	0.03	4%
	Fires	87,262	0.67	0.64	-0.03	-5%

Table G2: Average differences over all of the Northern California region, just treatment footprints throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	10,189,203	0.42	0.45	0.03	6%
	Treatments	162,031	0.54	0.54	-0.01	-1%
	Fires	855,730	0.28	0.60	0.32	112%
Flame Length (Forested Landscape)	Landscape	10,189,203	0.47	0.43	-0.05	-10%
	Treatments	162,031	0.36	0.34	-0.02	-6%
	Fires	855,730	0.64	0.32	-0.31	-49%
Flame Length (Forested WUI)	Landscape	248,257	0.37	0.36	-0.02	-5%
	Treatments	6,302	0.46	0.43	-0.02	-5%
	Fires	2,713	0.50	0.30	-0.20	-41%
Flame Length (Forested Roads)	Landscape	2,350,674	0.46	0.41	-0.05	-10%
	Treatments	71,678	0.38	0.37	-0.01	-4%
	Fires	132,094	0.61	0.28	-0.33	-53%
Flame Length (Forested Utilities)	Landscape	190,498	0.29	0.26	-0.03	-10%
	Treatments	6,716	0.32	0.28	-0.04	-11%
	Fires	7,218	0.60	0.25	-0.35	-59%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Drought Vulnerability (Forest Health)	Landscape	10,189,203	0.27	0.21	-0.05	-20%
	Treatments	154,104	0.21	0.16	-0.05	-24%
	Fires	855,730	0.29	0.05	-0.24	-81%
Grass Proportion Near Roads (Shrubland Health)	Landscape	355,313	0.91	0.90	-0.01	-1%
	Treatments	7,384	0.85	0.82	-0.04	-4%
	Fires	25,386	0.97	0.92	-0.05	-5%
Grass Proportion Away from Roads (Shrubland Health)	Landscape	1,696,660	0.93	0.91	-0.01	-2%
	Treatments	15,105	0.88	0.85	-0.03	-4%
	Fires	188,467	0.98	0.93	-0.05	-5%

Table G3: Average differences over all of the Central Coast region, just treatment footprints throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	729,878	0.45	0.45	0.01	1%
	Treatments	12,838	0.54	0.56	0.02	3%
	Fires	4,930	0.07	0.13	0.06	78%
Flame Length (Forested Landscape)	Landscape	729,878	0.41	0.38	-0.03	-7%
	Treatments	12,838	0.33	0.28	-0.05	-16%
	Fires	4,930	0.62	0.54	-0.08	-13%
Flame Length (Forested WUI)	Landscape	81,197	0.26	0.25	-0.01	-4%
	Treatments	3,545	0.33	0.29	-0.04	-11%
	Fires	60	0.42	0.42	0.00	-1%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Flame Length (Forested Roads)	Landscape	184,293	0.32	0.29	-0.03	-8%
	Treatments	7,013	0.34	0.30	-0.04	-13%
	Fires	1,190	0.54	0.49	-0.05	-8%
Flame Length (Forested Utilities)	Landscape	20,105	0.15	0.14	-0.02	-10%
	Treatments	447	0.30	0.30	0.00	0%
	Fires	34	0.10	0.05	-0.05	-45%
Drought Vulnerability (Forest Health)	Landscape	729,878	0.59	0.53	-0.05	-9%
	Treatments	15,573	0.72	0.53	-0.19	-26%
	Fires	4,930	0.46	0.32	-0.14	-30%
Grass Proportion Near Roads (Shrubland Health)	Landscape	442,750	0.68	0.71	0.03	5%
	Treatments	7,555	0.75	0.72	-0.03	-4%
	Fires	5,585	0.55	0.57	0.02	3%
Grass Proportion Away from Roads (Shrubland Health)	Landscape	2,726,809	0.73	0.74	0.02	2%
	Treatments	24,143	0.79	0.82	0.03	3%
	Fires	55,048	0.66	0.66	0.00	0%

Table G4: Average differences over all of the Sierra Nevada region, just treatment footprints throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	11,407,229	0.23	0.28	0.05	22%
	Treatments	293,567	0.16	0.21	0.06	36%
	Fires	1,457,138	0.17	0.55	0.38	221%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Flame Length (Forested Landscape)	Landscape	11,407,229	0.57	0.51	-0.06	-10%
	Treatments	293,567	0.62	0.53	-0.09	-14%
	Fires	1,457,138	0.64	0.29	-0.35	-55%
Flame Length (Forested WUI)	Landscape	424,853	0.68	0.64	-0.04	-6%
	Treatments	28,826	0.66	0.60	-0.06	-9%
	Fires	11,810	0.65	0.34	-0.31	-47%
Flame Length (Forested Roads)	Landscape	2,635,198	0.62	0.56	-0.06	-10%
	Treatments	129,591	0.63	0.55	-0.08	-13%
	Fires	331,273	0.63	0.29	-0.34	-54%
Flame Length (Forested Utilities)	Landscape	188,874	0.34	0.30	-0.03	-10%
	Treatments	13,176	0.57	0.47	-0.10	-18%
	Fires	18,644	0.53	0.27	-0.26	-48%
Drought Vulnerability (Forest Health)	Landscape	11,407,229	0.36	0.29	-0.06	-18%
	Treatments	312,756	0.43	0.30	-0.13	-30%
	Fires	1,457,138	0.46	0.09	-0.37	-80%
Grass Proportion Near Roads (Shrubland Health)	Landscape	668,984	0.87	0.85	-0.02	-2%
	Treatments	16,738	0.86	0.79	-0.07	-8%
	Fires	62,389	0.91	0.88	-0.03	-4%
Grass Proportion Away from Roads (Shrubland Health)	Landscape	3,792,631	0.88	0.86	-0.02	-2%
	Treatments	50,373	0.84	0.80	-0.04	-5%
	Fires	320,169	0.90	0.87	-0.02	-3%

Table G5: Average differences over all of the Southern California region, only for areas showing tree/shrub canopy disturbance in remote sensing, just treatment footprints

throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints, and treatment areas reflect the whole footprint, not only the visibly disturbed portion.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	539,532	0.16	0.16	-0.01	-3%
	Treatments	9,722	0.09	0.27	0.18	206%
	Fires	3,038	0.09	0.49	0.40	442%
Flame Length (Forested Landscape)	Landscape	539,532	0.62	0.61	-0.01	-2%
	Treatments	9,722	0.66	0.37	-0.30	-45%
	Fires	3,038	0.73	0.28	-0.45	-61%
Flame Length (Forested WUI)	Landscape	41,263	0.64	0.64	0.00	0%
	Treatments	2,482	0.61	0.33	-0.28	-46%
	Fires	26	0.55	0.37	-0.18	-33%
Flame Length (Forested Roads)	Landscape	122,332	0.63	0.62	-0.01	-1%
	Treatments	5,160	0.67	0.41	-0.26	-39%
	Fires	978	0.72	0.23	-0.49	-68%
Flame Length (Forested Utilities)	Landscape	20,616	0.14	0.14	0.00	0%
	Treatments	758	0.70	0.44	-0.25	-37%
	Fires	166	0.30	0.15	-0.15	-49%
Drought Vulnerability (Forest Health)	Landscape	539,532	0.41	0.41	0.00	0%
	Treatments	10,829	0.39	0.21	-0.18	-47%
	Fires	3,038	0.61	0.14	-0.47	-77%
Grass Proportion Near Roads (Shrubland Health)	Landscape	843,291	0.73	0.78	0.06	8%
	Treatments	11,171	0.82	0.83	0.01	1%
	Fires	19,703	0.77	0.70	-0.07	-9%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Grass Proportion Away from Roads (Shrubland health)	Landscape	2,797,628	0.80	0.85	0.04	6%
	Treatments	10,796	0.84	0.84	0.00	0%
	Fires	87,262	0.80	0.70	-0.10	-12%

Table G6: Average differences over all of the Northern California region, only for areas showing tree/shrub canopy disturbance in remote sensing, just treatment footprints throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints, and treatment areas reflect the whole footprint, not only the visibly disturbed portion.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	10,189,203	0.42	0.45	0.03	6%
	Treatments	162,031	0.36	0.41	0.05	14%
	Fires	855,730	0.26	0.70	0.44	166%
Flame Length (Forested Landscape)	Landscape	10,189,203	0.47	0.43	-0.05	-10%
	Treatments	162,031	0.51	0.36	-0.15	-29%
	Fires	855,730	0.65	0.22	-0.43	-66%
Flame Length (Forested WUI)	Landscape	248,257	0.37	0.36	-0.02	-5%
	Treatments	6,302	0.56	0.43	-0.13	-23%
	Fires	2,713	0.53	0.23	-0.30	-56%
Flame Length (Forested Roads)	Landscape	2,350,674	0.46	0.41	-0.05	-10%
	Treatments	71,678	0.51	0.36	-0.14	-28%
	Fires	132,094	0.63	0.19	-0.44	-69%
Flame Length (Forested Utilities)	Landscape	190,498	0.29	0.26	-0.03	-10%
	Treatments	6,716	0.50	0.37	-0.12	-25%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
	Fires	7,218	0.65	0.19	-0.46	-71%
Drought Vulnerability (Forest Health)	Landscape	10,189,203	0.27	0.21	-0.05	-20%
	Treatments	154,104	0.29	0.07	-0.22	-77%
	Fires	855,730	0.31	0.01	-0.30	-97%
Grass Proportion Near Roads (Shrubland Health)	Landscape	355,313	0.91	0.90	-0.01,	-1%
	Treatments	7,384	0.81	0.61	-0.20	-25%
	Fires	25,386	0.98	0.90	-0.08	-8%
Grass Proportion Away from Roads (Shrubland health)	Landscape	1,696,660	0.93	0.91	-0.01	-2%
	Treatments	15,105	0.87	0.71	-0.16	-18%
	Fires	188,467	0.98	0.92	-0.06	-6%

Table G7: Average differences over all of the Central Coast region, only for areas showing tree/shrub canopy disturbance in remote sensing, just treatment footprints throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints, and treatment areas reflect the whole footprint, not only the visibly disturbed portion.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	729,878	0.45	0.45	0.01	1%
	Treatments	12,838	0.57	0.54	-0.03	-5%
	Fires	4,930	0.10	0.27	0.16	159%
Flame Length (Forested Landscape)	Landscape	729,878	0.41	0.38	-0.03	-7%
	Treatments	12,838	0.33	0.26	-0.07	-20%
	Fires	4,930	0.60	0.36	-0.24	-40%
Flame Length (Forested WUI)	Landscape	81,197	0.26	0.25	-0.01	-4%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
	Treatments	3,545	0.41	0.24	-0.17	-42%
	Fires	60	0.46	0.32	-0.15	-32%
Flame Length (Forested Roads)	Landscape	184,293	0.32	0.29	-0.03	-8%
	Treatments	7,013	0.35	0.31	-0.04	-10%
	Fires	1,190	0.54	0.37	-0.17	-32%
Flame Length (Forested Utilities)	Landscape	20,105	0.15	0.14	-0.02	-10%
	Treatments	447	0.50	0.28	-0.22	-44%
	Fires	34	0.20	0.08	-0.12	-59%
Drought Vulnerability (Forest Health)	Landscape	729,878	0.59	0.53	-0.05	-9%
	Treatments	15,573	0.81	0.38	-0.43	-53%
	Fires	4,930	0.55	0.19	-0.36	-65%
Grass Proportion Near Roads (Shrubland Health)	Landscape	442,750	0.68	0.71	0.03	5%
	Treatments	7,555	0.75	0.57	-0.18	-23%
	Fires	5,585	0.67	0.61	-0.06	-9%
Grass Proportion Away from Roads (Shrubland health)	Landscape	2,726,809	0.73	0.74	0.02	2%
	Treatments	24,143	0.81	0.75	-0.06	-8%
	Fires	55,048	0.80	0.72	-0.07	-9%

Table G8: Average differences over all of the Sierra Nevada region, only for areas showing tree/shrub canopy disturbance in remote sensing, just treatment footprints throughout the region, and just fire footprints throughout the region (Oct 2020 through September 2024). Landscape areas include fire and treatment footprints, and treatment areas reflect the whole footprint, not only the visibly disturbed portion.

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
Beneficial Fire (Forested Landscape)	Landscape	11,407,229	0.23	0.28	0.05	22%
	Treatments	293,567	0.13	0.32	0.19	150%
	Fires	1,457,138	0.17	0.67	0.50	305%
Flame Length (Forested Landscape)	Landscape	11,407,229	0.57	0.51	-0.06	-10%
	Treatments	293,567	0.66	0.39	-0.27	-40%
	Fires	1,457,138	0.65	0.19	-0.47	-72%
Flame Length (Forested WUI)	Landscape	424,853	0.68	0.64	-0.04	-6%
	Treatments	28,826	0.69	0.44	-0.24	-35%
	Fires	11,810	0.67	0.22	-0.46	-68%
Flame Length (Forested Roads)	Landscape	2,635,198	0.62	0.56	-0.06	-10%
	Treatments	129,591	0.68	0.40	-0.28	-41%
	Fires	331,273	0.64	0.17	-0.46	-73%
Flame Length (Forested Utilities)	Landscape	188,874	0.34	0.30	-0.03	-10%
	Treatments	13,176	0.67	0.42	-0.26	-38%
	Fires	18,644	0.59	0.19	-0.40	-68%
Drought Vulnerability (Forest Health)	Landscape	11,407,229	0.36	0.29	-0.06	-18%
	Treatments	312,756	0.48	0.09	-0.39	-81%
	Fires	1,457,138	0.50	0.03	-0.47	-94%
Grass Proportion Near Roads (Shrubland Health)	Landscape	668,984	0.87	0.85	-0.02	-2%
	Treatments	16,738	0.84	0.63	-0.21	-25%
	Fires	62,389	0.93	0.87	-0.05	-6%
Grass Proportion Away from Roads (Shrubland health)	Landscape	3,792,631	0.88	0.86	-0.02	-2%
	Treatments	50,373	0.77	0.57	-0.20	-26%

Metric	Footprint Type	Area (Acres)	Fall 2020 Proportion	Fall 2024 Proportion	Absolute Difference	Percent Difference
	Fires	320,169	0.91	0.87	-0.04	-4%