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Via e-mail: Climate@Resources.ca.gov

June 23, 2017

Natural Resources Agency
1416 Ninth St, Suite 1311
Sacramento, CA 95814

Re: Comments on the Forest Chapter of the Draft Report *Safeguarding California Plan: 2017 Update, California's Climate Adaptation Strategy*

The Center for Biological Diversity ("Center") submits the following comments on the Forest chapter of the draft report *Safeguarding California Plan: 2017 Update, California's Climate Adaptation Strategy* ("Plan" or "Draft Plan"). The Center is a national, non-profit conservation organization dedicated to the protection of imperiled species, their habitats, and the environment through science, policy, and environmental law. The Center has more than 1.3 million members and online activists throughout the United States, and offices including in Oakland, Los Angeles, and Joshua Tree, California. The Center's Climate Law Institute works to reduce U.S. greenhouse gas emissions and other air pollution to protect biological diversity, the environment, and human health and welfare which are threatened by climate change.

The Center participated extensively in commenting on the *2009 California Climate Adaptation Strategy* and the 2014 update since many of the issues covered in the plan are central to the conservation mission of our organization. The Center appreciates the state's commitment to producing an updated climate change adaptation plan that recognizes the escalating threats to health, well-being, and the environment. We particularly appreciate the emphasis on the importance of using science-based solutions to address climate change threats.[1] Many of the Draft Plan's chapters and their recommendations, such as the Biodiversity chapter and Ocean and Coast chapter, are well-done.

However, the Forest chapter, authored by CalFIRE, stands out from the rest of the Draft Plan in failing to reflect the best available science and, as a result, it recommends management actions that are likely to cause harm to forest ecosystems, lead to higher greenhouse gas emissions in the state, and decrease, rather than increase, forest resilience to the growing stresses from climate change. These comments on the Forest chapter (1) identify statements and recommendations that are not supported by the best available science, and (2) propose modified

[1] One of the guiding principles of the *2009 California Climate Adaptation Strategy* was to "[u]se the best available science in identifying climate change risks and adaptation strategies."

or alternative science-based recommendations for achieving the Forest chapter's stated goal of improving forest resilience under climate change.[2]

The state must update its adaptation strategy every three years as directed by Assembly Bill 1482. The Natural Resources Agency, which coordinates the updates, has the opportunity and responsibility to ensure that the 2017 Forest chapter update and subsequent updates actively incorporate the findings of the best available science. We urge the Natural Resources Agency to direct the preparation of a substantially revised Forest chapter that has a robust scientific basis, accurately represents the range of findings and uncertainty in the published scientific literature, and recommends strategies that are likely to be effective in increasing forest resilience to climate change while protecting ecological values and functions.

I. The Forest Chapter does not identify the climate-change-related problems it is trying to address and makes management recommendations that are not grounded in science.

A fundamental task for each of the Plan's chapters is to identify the climate-change-related problems that it is trying to address with its management recommendations. For example, sea level rise is identified in the Ocean and Coast chapter, and diminishing Sierra snowpack is considered in the Water chapter. However, the Forest chapter either fails to identify the climate-change-related problems it is trying to address, or asserts that there is a problem (e.g., increasing fire severity in California's forests) when in fact that assertion is not supported by the scientific evidence on the issue. The Forest chapter must have a robust, scientific basis for the climate-related stressors it is addressing and the proposed actions to ameliorate these stressors. Otherwise, the proposed actions risk being counter-productive.

For example, the introduction to the Forest chapter makes one vague statement—without any specific citations in support—that climate change is already affecting "tree survival and growth, forest composition, the range and distribution of tree species, and forest health and productivity."[3] While it is generally true that climate change is having widespread effects across species and ecosystems, the Forest chapter does not identify exactly which of these issues, if any, it is trying to address. The absence of any scientific citation for the statement also makes it difficult if not impossible to assess the importance of these problems and the effectiveness (or ineffectiveness) of the Forest chapter in addressing them.

The introduction then jumps to the logically disconnected conclusion that in order to improve forest health and resilience, the state should invest in forest management that includes harvesting biomass and manufacturing wood products: "In order to improve forest health and resilience, investments must be made to improve the social and economic resilience of forested communities, and their capacity to carry out forest management activities. Building rural and tribal restoration economies for achieving forest health outcomes will entail creating jobs to manage forests, harvest biomass, and manufacture wood products."[4] However, the chapter

[2] The primary goal of the Forest chapter is to provide a "framework for improving forest resiliency in a changing climate." Plan at 84.
[3] Plan at 84.
[4] Plan at 84.

nowhere provides scientific support for the argument that taking more carbon out of the forest (e.g., through biomass harvesting) and either burning it in bioenergy plants or making it into wood products will improve forest health and resilience. As detailed below, scientific research indicates that the proposed increases in logging/thinning paired with burning of woody biomass in bioenergy facilities will reduce forest health and resilience and lead to higher greenhouse gas emissions in the state.

The introduction also states that the chapter's proposed actions "align with recommendations laid out in the Forest Carbon Plan, a state-wide strategy to manage our forest landscapes as a sink of carbon."[5] However, the draft Forest Carbon Plan, released in January of 2017 for public comment and also primarily authored by CalFire, is highly problematic and has not yet been adopted by the state. As summarized in a detailed comment letter by eleven scientific institutions and environmental organizations, the draft Forest Carbon Plan misrepresents the state of the science and scientific uncertainty on core issues and recommends management actions that are likely to undermine forest carbon storage and forest health:

> In its current draft, the [Forest Carbon] Plan misrepresents the state of science and scientific uncertainty on core issues, omits mention of hundreds of highly relevant studies, and is founded on scientifically unsupported assertions. The Plan's core management actions are not only poorly conceived and unsupported, but are also likely to undermine the goal of maintaining California's forests as a carbon sink while causing substantial environmental harm to California's forest ecosystems.[6]

Therefore, it is troubling that the Forest chapter relies on the scientifically unsound draft Forest Carbon Plan. As detailed below, many core recommendations proposed by the Forest chapter are similarly not grounded in the best available science.

II. Recommendation F-1 ("enhance forest health through fuel reduction, thinning, and managed fire treatments") justifies large-scale increases in logging/thinning based on scientifically unfounded premises.

A. Recommendation F-1 incorrectly asserts that wildfire in California's forests is becoming increasingly severe, as a justification for continued logging and fire suppression.

Recommendation F-1 focuses heavily on increasing the pace and scale of logging/thinning in California's forests. In the rationale for this recommendation, the chapter correctly acknowledges that current and historical fire suppression and logging have harmed California's forests, and that fire is a natural component of California's forest ecosystems.[7] However, the chapter then erroneously asserts that wildfire is "increasingly severe" when it

[5] Plan at 84.
[6] Center for Biological Diversity et al. 2017. Comments on California Forest Carbon Plan (January 20, 2017 Draft). Comments submitted March 17, 2017.
[7] Plan at 86: "While forests naturally experience fire in regular cycles…"

returns to fire-suppressed forests, compared to historic levels.[8] Therefore, rather than proposing to move away from a continued policy of logging and fire suppression in California's forests—the very policy the chapter identifies as harmful—the chapter uses this inaccurate assertion to support its recommendations for continued logging, including large increases in the "pace and scale" of thinning and other fuels reduction (e.g., sub-recommendations F-1.1 and F-1.2).

The Plan cites a single source (Mallek et al. 2013) to assert that fire-suppressed forests are burning more severely.[9] However, this study does not represent the weight of the scientific evidence on trends in fire severity in California's forests. As documented below, a large body of scientific research on fire trends in California demonstrates that (1) fire-suppressed forests are not burning more severely, (2) there is no increasing trend in fire severity in California's forests, (3) there is no increasing trend in high-severity patch size, (4) there is no clear trend in area burned, and (5) California's forests are experiencing much less fire than there was historically.

1. Fire-suppressed forests are not burning more severely.

The Forest chapter omits mention of the large body of empirical studies in California's forests that have found that fire-suppressed forests are not burning at higher fire severity. Specifically, six empirical studies found that the most long-unburned (most fire-suppressed) forests burned mostly at low/moderate-severity, and did not have higher proportions of high-severity fire than less fire-suppressed forests. Forests that were not fire suppressed (e.g., those that had not missed fire cycles, i.e., Condition Class 1, or "Fire Return Interval Departure" class 1) generally had levels of high-severity fire similar to, or higher than, those in the most fire-suppressed forests, as found by Odion et al. 2004 (Klamath-Siskiyou), Odion and Hanson 2006 (Sierra Nevada), Odion and Hanson 2008 (Sierra Nevada), Odion et al. 2010 (Klamath Mountains), Miller et al. 2012 (Sierra Nevada), and van Wagtendonk et al. 2012 (Sierra Nevada).[10]

Recently, Steel et al. (2015) reported modeling results that predicted a modest increase in fire severity with increasing time since fire: 12% high-severity fire at 10 years after fire up to 20% high-severity fire at 75 years post-fire.[11] Thus, even the most long-unburned forests (>75 years since the last fire) were predicted to have mostly low/moderate-severity fire effects.

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[8] Plan at 86: "When fire does return to many of these forests, it is increasingly severe, compared to historic levels."

[9] Plan at 86: "When fire does return to many of these forests, it is increasingly severe, compared to historic levels," where the link directs the user to Mallek et al. (2013).

[10] Odion, D.C. et al. 2004. Patterns of fire severity and forest conditions in the Klamath Mountains, northwestern California. Conservation Biology 18: 927-936; Odion, D.C. and C.T. Hanson. 2006. Fire severity in conifer forests of the Sierra Nevada, California. Ecosystems 9: 1177-1189; Odion, D.C. and C.T. Hanson. 2008. Fire severity in the Sierra Nevada revisited: conclusions robust to further analysis. Ecosystems 11: 12-15; Odion, D.C. et al. 2010. Alternative community states maintained by fire in the Klamath Mountains, USA. Journal of Ecology; Miller, J.D. et al. 2012. Trends and causes of severity, size, and number of fires in northwestern California, USA. Ecological Applications 22:184-203; van Wagtendonk, J.W. et al. 2012. Factors associated with the severity of intersecting fires in Yosemite National Park, California, USA. Fire Ecology 8: 11-32.

[11] Steel, Z. L. et al. 2015. The fire frequency-severity relationship and the legacy of fire suppression in California forests. Ecosphere 6(1):8.

Moreover, even the modest predicted increase in fire severity reported by Steel et al. (2015) must be viewed with caution because it was based upon almost no data for mixed-conifer stands that had experienced fire less than 75 years previously (see Fig. 4 of Steel et al. 2015).

2. Fire severity is not increasing in California's forests.

The Plan asserts that fire severity is increasing in California's forests, without providing any supporting evidence.[12] However, numerous recent published, peer-reviewed studies have concluded that fire severity is not increasing in California's forests. These studies are summarized in a scientific literature review by Doerr and Santin (2016), which concluded: "For the western USA, [current studies] indicate little change overall [in high-severity fire trends], and also that area burned at high severity has overall declined compared to pre-European settlement."[13]

Specifically, the Forest chapter fails to acknowledge ten studies that found no significant trends in fire severity in California's forests in terms of proportion, area, and/or patch size: Schwind 2008 (California forests), Collins et al. 2009 (central Sierra Nevada), Hanson et al. 2009 (Klamath, southern Cascades), Dillon et al. 2011 (Northwest California), Miller et al. 2012 (four Northwest CA forests), Hanson and Odion 2014 (Sierra Nevada, southern Cascades), Odion et al. 2014 (eastern and western Sierra Nevada, eastern Cascades), Baker 2015 (California dry pine and mixed conifer forests), Picotte et al. 2016 (California forest and woodland), and Keyser and Westerling 2017 (California forests).[14]

Hanson and Odion (2014) conducted the first comprehensive assessment of fire intensity since 1984 in the Sierra Nevada using 100% of available fire intensity data, and found no increasing trend in terms of high-intensity fire proportion, area, mean patch size, or maximum

[12] Plan at 163: "Fire severity has been increasing beyond the historical norm."

[13] Doerr, S.H. and C. Santin. 2016. Global trends in wildfire and its impacts: perceptions versus realities in a changing world. Philosophical Transactions Royal Society B 371: 20150345.

[14] Schwind, B. 2008. Monitoring trends in burn severity: report on the Pacific Northwest and Pacific Southwest fires (1984 to 2005). US Geological Survey; Collins, B.M. et al. 2009. Interactions among wildland fires in a long-established Sierra Nevada natural fire area. Ecosystems 12:114–128; Hanson, C.T. et al. 2009. Overestimation of fire risk in the Northern Spotted Owl Recovery Plan. Conservation Biology 23: 1314–1319; Dillon, G.K., et al. 2011. Both topography and climate affected forest and woodland burn severity in two regions of the western US, 1984 to 2006. Ecosphere 2: Article 130; Miller, J.D. et al. 2012. Trends and causes of severity, size, and number of fires in northwestern California, USA. Ecological Applications 22: 184-203; Hanson, C.T., and D.C. Odion. 2014. Is fire severity increasing in the Sierra Nevada mountains, California, USA? International Journal of Wildland Fire 23: 1-8; Odion, D.C. et al. 2014. Examining historical and current mixed-severity fire regimes in Ponderosa pine and mixed-conifer forests of western North America. PLoS ONE 9(2): e87852; Baker, W.L. 2015. Are high-severity fires burning at much higher rates recently than historically in dry-forest landscapes of the Western USA? PLoS ONE 10(9): e0136147; Picotte, J.J. et al. 2016. 1984-2010 trends in fire burn severity and area for the coterminous US. International Journal of Wildland Fire 25: 413-420; Keyser, A. and A.L. Westerling. 2017. Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States. Environmental Research Letters 12: 065003.

patch size. Hanson and Odion (2014) and Hanson and Odion (2015)[15] reviewed the approach of the two studies cited by the Plan as reporting an increasing trend in fire severity (Miller and Safford 2012, Mallek et al. 2013) and found that these studies had a methodological flaw that resulted in the erroneous exclusion of much of the high-severity fire data in conifer forests in the earlier years of the time series, leading to the false appearance of increasing high-severity fire.

Of note, Baker (2015) found that the rate of recent (1984–2012) high-severity fire in dry pine and mixed conifer forests in California is within the range of historical rates, or is too low. There were no significant upward trends from 1984–2012 for area burned and fraction burned at high severity. The author concluded that "[p]rograms to generally reduce fire severity in dry forests are not supported and have significant adverse ecological impacts, including reducing habitat for native species dependent on early-successional burned patches and decreasing landscape heterogeneity that confers resilience to climatic change."

Most recently, Keyser and Westerling (2017) tested trends for high severity fire occurrence for western United States forests, for each state and each month. The study found no significant trend in high severity fire occurrence over 1984-2014, except for Colorado. The study also found no significant increase in high severity fire occurrence by month during May through October, and no correlation between fraction of high severity fire and total fire size.

3. High-severity patch size is not increasing in California's forests.

The Plan suggests that high-severity burn patches are increasing in size, without citing any supporting studies.[16] In contrast to this assertion, Hanson and Odion (2014) analyzed all available fire severity data, 1984–2010, over the entire Sierra Nevada ecoregion and found no trend in high-severity fire mean annual patch size or maximum annual patch size, but this study was not acknowledged. Furthermore, the Plan's statements on the sizes of high severity burn patches are demonstrably false. MTBS mapping data clearly show that the Plan's assertion of a 50,000-acre high severity patch in the Rim Fire and a 30,000-acre high-severity patch in the King Fire are incorrect and dramatically over-estimated.[17]

4. There is no clear trend in area burned in California's forests.

Several studies have found no significant increase in area burned in California's forests in recent decades. Dennison et al. (2014) found no significant increase in annual fire area in the Sierra Nevada/Klamath/Cascades forest ecoregion in California during the 1984-2011 study period, nor a significant trend toward an earlier fire season in this or any other western

[15] Hanson, C.T. and D.C. Odion. 2015. Sierra Nevada fire severity conclusions are robust to further analysis: a reply to Safford et al. International Journal of Wildland Fire 24: 294-295.

[16] Plan at 163: "High severity burn patches were historically small, commonly under 10 acres in size, which allowed living trees on the edges to quickly reseed the burned area, and it created diverse habitat in a small area. In contrast to this healthy functionality, the King Fire had a single high-severity burn patch of over 30,000 acres in size and the Rim Fire had a high-severity burn patch over 50,000 acres."

[17] U.S. Forest Service and U.S. Geological Survey. 2014. Acreage of burn severity for the California Rim Fire, 2013; U.S. Forest Service and U.S. Geological Survey. 2015. Acreage of burn severity for the California King Fire, 2014.

ecoregion.[18] Similarly, Dillon et al. (2011) detected no trends in annual area burned in the two ecoregions that occur in part in northern California (i.e., Pacific and Inland Northwest) during the 1984-2006 study period.[19]

5. California's forests are experiencing much less fire than there was historically.

The Forest chapter does not disclose that the overwhelming weight of scientific evidence indicates there is currently substantially less fire of all severities in the great majority of western U.S. mixed-conifer, mixed-evergreen, and yellow pine forests than there was historically (*see* literature summarized in Hanson et al. 2015).[20] It is well-established that California's forests are experiencing a significant fire deficit compared with pre-settlement conditions (Mouillet and Field 2005, Stephens et al. 2007, Marlon et al. 2012, Odion et al. 2014, Parks et al. 2015).[21]

According to Stephens et al. (2007), prior to 1800, an estimated 18 to 47 times more area burned each year in California, including 20 to 53 times more forest area, than has burned annually during recent decades: "skies were likely smoky much of the summer and fall." This study estimated that 1.8 million to 4.8 million hectares burned each year in California prior to 1800, of which 0.5 million to 1.2 million hectares were forest, compared to just 102,000 hectares burned each year between 1950-1999, of which 23,000 hectares were forest. Based on this extreme fire deficit, Stephens et al. (2007) recommend "increasing the spatial extent of fire in California [as] an important management objective."

The recent analysis by Parks et al (2015) reported that California forests, including Sierra Nevada and southern Cascades forests, experienced a significant fire deficit during the 1984-2012 study period, attributed to fire suppression activities. Odion et al. (2014) similarly found multiple lines of corroborating evidence that there is currently much less high-severity fire in California's mixed-conifer and ponderosa pine forests than compared with historical levels. Mallek et al. (2013) also confirmed the fire deficit in California's forests, concluding that "modern rates of burning are far below presettlement levels for all forest types."

B. The projected impacts of climate change on wildfire activity in California's forests are uncertain.

The Forest chapter's justification for Recommendation F-1 also states that most forest areas will experience a large increase in burned area by the end of the century, citing one source

[18] Dennison, P.E., Brewer, S.C., Arnold, J.D., and M.A. Moritz. 2014. Large wildfire trends in the western United States, 1984-2011. Geophysical Research Letters 41: 2928–2933.
[19] Dillon, G.K., et al. 2011.
[20] Hanson et al. 2015.
[21] Mouillot, F. and C. Field. 2005. Fire history and the global carbon budget: a 1º x 1º fire history reconstruction for the 20th century. Global Change Biology 11: 398-420; Stephens, S.L. et al. 2007. Prehistoric fire area and emissions from California's forests, woodlands, shrublands and grasslands. Forest Ecology and Management 251: 205-216; Marlon, J.R. et al. 2012. Long-term perspective on wildfires in the western USA. PNAS 109: E535–E543; Odion, D.C. et al. 2014; Parks, S.A. et al. 2015. Wildland fire deficit and surplus in the western United States, 1984-2012. Ecosphere 6: Article 275.

(Westerling et al. 2011).[22] While climate change will almost certainly alter fire activity, scientific studies project that future fire severity in California's forests is likely to stay the same or decrease, and studies show no consensus on how climate change is likely to affect future fire probability or area burned.[23] However, the Forest chapter fails to acknowledge the considerable uncertainty in scientific projections of climate change effects on future fire activity.

In terms of fire severity, a recent study by Parks et al. (2016) projected that even in hotter and drier future forests, there will be a decrease or no change in high-severity fire effects in nearly every forested region of the western U.S., including California, due to reductions in combustible understory vegetation over time.[24] Other studies forecasting changes in the probability of burning and/or large fire occurrence project a varied mix of local increases or decreases of fire, varying by forest region (Krawchuk and Moritz 2012, Moritz et al. 2012, and Westerling and Bryant 2008).[25]

Studies that project changes in burned area in California's forests under climate change scenarios similarly show no consensus. Four studies project a mix of increases and decreases in total area burned depending on the region (Lenihan et al. 2003, Lenihan et al. 2008, Krawchuk et al. 2009, and Spracklen et al. 2009).[26] One study projects an overall decrease in area burned (McKenzie et al. 2004), while two studies project increases (Fried et al. 2004 in a small region in the Amador-El Dorado Sierra foothills; Westerling et al. 2011).[27] The projected increases in Westerling et al. (2011) are relatively modest, with median increases in area burned of 21% and 23% by 2050, and 20% and 44% by 2085, relative to 1961-1990 under lower (B1) and higher (A2) emissions scenarios respectively. Given that the average annual burned area in California in the past several decades was many times lower than the burned area historically, these projected

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[22] Plan at 86: "By 2085, most of the forested areas in Northern California are predicted to experience a growth in burned area of over 100 percent above 1975 reference levels."

[23] Whitlock, C. et al. 2015. Climate Change: Uncertainties, Shifting Baselines, and Fire Management. Pp. 265-289 in The Ecological Importance of Mixed Severity Fires: Nature's Phoenix. D.A. DellaSala and C.T. Hanson, eds. Elsevier, Amsterdam, Netherlands.

[24] Parks, S.A. et al. 2016. How will climate change affect wildland fire severity in the western US? Environmental Research Letters 11: 035002.

[25] Krawchuk, M. A., and M. A. Moritz. 2012. Fire and Climate Change in California. California Energy Commission. Publication number: CEC-500-2012-026; Moritz, M. et al. 2012. Climate change and disruptions to global fire activity. Ecosphere 3 (6): 1-22; Westerling, A. and B. Bryant. 2008. Climate change and wildfire in California. Climate Change 87: S231– S249.

[26] Lenihan, J.M. et al. 2003. Climate change effects on vegetation distribution, carbon, and fire in California. Ecological Applications 13: 1667-1681; Lenihan, J.M. et al. 2008. Response of vegetation distribution, ecosystem productivity, and fire to climate change scenarios for California. Climate Change 87(Suppl. 1): S215-S230; Krawchuk, M.A. et al. 2009. Global pyrogeography: the current and future distribution of wildfire. PloS ONE 4: e5102; Spracklen, D.V. et al. 2009. Impacts of climate change from 2000 to 2050 on wildfire activity and carbonaceous aerosol concentrations in the western United States. Journal of Geophysical Research 114: D20301.

[27] McKenzie, D. et al. 2004. Climatic change, wildfire, and conservation. Conservation Biology 18: 890-902; Fried, J.S. et al. 2004. The impact of climate change on wildfire severity: A regional forecast for northern California. Climatic Change 64 (1–2):169–191; Westerling, A.L. et al. 2011. Climate change and growth scenarios for California wildfire. Climatic Change 109 (Suppl 1): S445-S463.

increases in fire activity in California would likely remain well within the historical range of the past several centuries.

C. The proposed increases in thinning/logging are likely to reduce forest resilience.

Current research suggests that forest management treatments focused on logging/thinning trees to increase resilience to climate change stressors can be counter-productive, and many studies recommend restoring natural disturbance processes to increase resilience.

Numerous studies caution against forest management treatments aimed at reducing density to increase forest resilience. Carnwath et al. (2016) noted that management activities to reduce tree density with the purpose of increasing stand resilience often target trees that may be the most drought-resilient, producing counter-productive results.[28] Similarly, D'Amato et al. (2013) concluded that "heavy thinning treatments applied to younger populations, although beneficial at reducing drought vulnerability at this stage, may predispose these populations to greater long-term drought vulnerability."[29] Van Gunst et al. (2016) concluded that "no single density-reduction forest management strategy will increase forest resilience under all climate periods and in all forest types."[30]

Keeling et al. (2006) emphasized the importance of restoring ecological processes, especially wildfire, rather than management that tries to create specific stand conditions.[31] Keeling's study in ponderosa pine/Douglas-fir communities found that "fire and absence of fire produce variable effects in the understory and different rates of successional change in the overstory across varied landscapes." The authors cautioned "against specific targets for forest structure in restoration treatments, and underscore the importance of natural variability and heterogeneity in ponderosa pine forests." Further, "management may need to emphasize restoration of natural ecological processes, especially fire, rather than specific stand conditions."

D. Recommendation F-1 should be revised to support management that (1) moves away from fire suppression and large-scale forest thinning policies and toward restoring mixed-severity fire regimes and other natural disturbance processes and (2) keeps more biomass in the forest by reducing logging levels and lengthening harvest rotations on private lands and national forest.

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[28] Carnwath, G.C. and C.R. Nelson. 2016. The effect of competition on response to drought and interannual climate variability of a dominant conifer tree of western North America. Journal of Ecology 104: 1421-1431.
[29] D'Amato, A.W. et al. 2013. Effects of thinning on drought vulnerability and climate response in north temperate forest ecosystems. Ecological Applications 23: 1735-1742.
[30] Van Gunst, K.J. et al. 2016. Do denser forests have greater risk of tree mortality: a remote sensing analysis of density-dependent forest mortality. Forest Ecology and Management 359: 19-32.
[31] Keeling, E.G. et al. 2006. Effects of fire exclusion on forest structure and composition in unlogged ponderosa pine/Douglas-fir forests. Forest Ecology and Management 327: 418-428.

We recommend that the Forest chapter propose science-based actions to increase forest ecosystem resilience and health by restoring forest heterogeneity and complexity. Management should work with fire instead of against it, and should support biodiversity and ecological functions of intact forests while promoting long-term carbon storage and sequestration. Specifically, we recommend that Recommendation F-1 focus on the following management actions: (1) moving away from fire suppression and large-scale forest thinning policies and toward restoring natural mixed-severity fire regimes and other natural disturbance processes; and (2) maintaining biomass in the forest by reducing logging levels and lengthening harvest rotations on private lands and national forest.

Restoring forest health and increasing forest resilience requires reestablishing the natural ecological disturbances that forests and wildlife evolved with. Wildlife evolved with mixed-severity fire, not mechanical treatments. Forest health is therefore best achieved through management that seeks to put mixed-severity fire back on the landscape (such as via managed wildland fire). For example, mixed-severity fire regimes are the predominant fire regime for the ponderosa pine and mixed conifer forests in California.[32] Managers who want to integrate biodiversity conservation and climate adaptation with responsible fire management should recognize the vital role of variation in fire severity in maintaining successional diversity and fire-dependent biota, and should allow natural rates of ecological succession. These effects have generally diminished. As a result, more fire, including high-severity fire where it is in deficit, is an ecologically desirable goal.

Mechanical thinning, on the other hand, does not mimic natural wildfire and can reduce the value of mature forest habitat by reducing structural complexity, which many rare wildlife species preferentially select. The Plan should be especially careful about the pressures to promote commercial logging under the guise of "restoration" or "resiliency." In this regard, we are reminded of Six et al. (2014)'s cautionary note. These researchers warned that the pressure to thin forests as bark beetle treatments, often as a means to provide revenue to the commercial timber industry, without scientific understanding of treatment effects, can lead to "more harm than good":

> That pressure, to "do something", might also interact with the uncertainty about which choices are effective and appropriate (as with beetle timber harvest treatments) to create an opportunity for political pressures to force the adoption of particular choices that benefit specific interest groups [143]. It is perhaps no accident that the beetle treatments that have been most aggressively pushed for in the political landscape allow for logging activities that might provide revenue and jobs for the commercial timber industry. The result is that the push to "do something," uncertainty, and political pressures might lead us to act to respond to climate change before we understand the consequences of what we are doing, in the end producing more harm than good.[33]

[32] See literature review on mixed-severity fire in Center for Biological Diversity et al. 2017.
[33] Six, D.L. et al. 2014. Management for mountain pine beetle outbreak suppression: does relevant science support current policy? Forests 5: 103-133, at 124.

At present, the Forest chapter has one sub-recommendation on potential use of prescribed and managed fire as a restoration tool.[34] The chapter should expand this recommendation, drawing upon the best available and most recent science on the use of wildfire as an ecosystem function and management tool.[35] The chapter should include specific actions for the restoration of wildfire, such as managed wildland fire in which land managers make a decision to allow lightning-caused fires to burn, with the desired ecological condition of creating mixed-severity fire effects in order to enhance natural heterogeneity and benefit wildlife. The chapter should reflect the numerous scientific studies showing that areas that have missed multiple fire returns still burn mostly at low and moderate severity, so it is often not necessary to thin a forest prior to restoring mixed-severity fire to these forests. In this context, thinning is unnecessary, expensive, carbon-emitting, and should not be used as a precondition to delay the restoration of mixed-severity fire to forest ecosystem through managed wildland fire and prescribed mixed-severity fire.

III. Recommendation F-2 ("increase protection of forested lands, reduce conversion to non-forest uses, and facilitate reforestation opportunities to result in a more stable forested land base") relies on a scientifically unsupported assertion that forests need reforestation treatments after wildfire.

We strongly support the first two components of recommendation F-2 to increase protection of forested lands and reduce conversion to non-forest uses, although we do not agree with sub-recommendation F-2.4 on incentivizing timber harvest.[36] However, we do not support the recommendation for reforestation treatments after wildfire (e.g., F-2.1 and F-2.7). Contrary to the Forest chapter's assertion that forests need reforestation treatments to regenerate after wildfire,[37] most published studies that have investigated this issue have found substantial, heterogeneous natural conifer regeneration following high-severity fire in mixed-conifer and yellow pine forests (Raphael et al. 1987, Shatford et al. 2007, Donato et al. 2009, Haire and McGarigal 2010, Crotteau et al. 2013, DellaSala and Hanson 2015),[38] especially given that

[34] Plan at 87: "Promote the increased use of prescribed and managed fire to restore natural fire regimes and forest health. Facilitate cooperative efforts among private, state, tribal, and federal entities to apply prescribed and managed fire at an ecologically meaningful scale."

[35] For example, see DellaSala, D.A. et al. 2014. Complex early seral forests of the Sierra Nevada: what are they and how can they be managed for ecological integrity? Natural Areas Journal 34:310-324; Odion, D.C. et al. 2014. Examining historical and current mixed-severity fire regimes in Ponderosa pine and mixed-conifer forests of western North America. PLoS ONE 9(2): e87852; Schoennagel, T. et al. 2017. Adapt to more wildfire in western North American forests as climate changes. PNAS doi/10.1073/pnas.1617464114.

[36] Plan at 88: "Incentivize working forests that can return revenue from timber harvesting to allow small forest landowners to cover taxes and other expenses of maintaining forest lands, thereby preventing land fragmentation and conversion to non-forest land uses."

[37] Plan at 88: "In the absence of reforestation, natural succession in areas impacted by high intensity wildfire may result in an effective type conversion from forest lands to chaparral or shrub dominated communities."

[38] Raphael, M.G. et al. 1987. Breeding bird populations during twenty-five years of postfire succession in the Sierra Nevada. The Condor 89: 614-626; Shatford, J.P.A. et al. 2007. Conifer regeneration after forest fire in the Klamath-Siskiyous: how much, how soon? Journal of Forestry, April/May: 139-146; Donato, D.C. et al. 2009. Vegetation response to a short interval between high-severity wildfires in a mixed-

natural post-fire conifer regeneration continues to occur in successive years post-fire (Shatford et al. 2007). This is especially true when such studies assess natural succession over time, since in the driest forests natural post-fire conifer regeneration in high-severity fire patches may be very sparse or absent for the first decade or so post-fire, but then increases substantially (Haire and McGarigal 2010).

It is also troubling that the chapter fails to acknowledge the ecological harms caused by reforestation treatments which can reduce forest health and resilience. Reforestation treatments after wildfire or bark beetle outbreaks are typically associated with salvage logging of dead and living trees, which has been shown to hinder regeneration and be ecologically destructive (Donato et al. 2006, Lindenmayer and Noss 2006).[39] Shrub eradication, often through spraying herbicides, is commonly used during reforestation treatments, since natural shrub regeneration is viewed as competing with planted seedlings.[40] As a result, reforestation treatments often result in plantations that are unnatural and significantly different from naturally revegetated areas because they lack snags which provide essential habitat for wildlife, lack shrubs and other natural ground vegetation, and are subjected to toxic herbicides.

As an alternative, after natural disturbances such as wildfire and bark beetle outbreaks, natural seedling regeneration may best allow the survival of genotypes that are better adapted to changing regional climate conditions, thereby promoting forest resilience to climate change through natural selection (Alfaro et al. 2014).[41] For example, several studies suggest that bark beetles may act as a selective agent in shifting forest stands to those most suited to the prevailing climate conditions (Millar et al. 2007, Millar et al. 2012, Knapp et al. 2013).[42]

IV. Recommendation F-4 ("promote rural and tribal economic development by expanding wood products markets, biomass utilization and outdoor recreation")

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evergreen forest. Journal of Ecology 97: 142-154; Haire, S.L. and K. McGarigal. 2010. Effects of landscape patterns of fire severity on regenerating ponderosa pine forests (*Pinus ponderosa*) in New Mexico and Arizona, USA. Landscape Ecology 25: 1055-1069; Crotteau, J.S. et al. 2013. Post-fire regeneration across a fire severity gradient in the southern Cascades. Forest Ecology and Management 287: 103-112; DellaSala, D.A. and C.T. Hanson (eds). 2015. The ecological importance of mixed-severity fires: nature's phoenix. Elsevier, United Kingdom.

[39] Donato, D.C. et.al. 2006. Post-wildfire logging hinders regeneration and increases fire risk. Science 311: 352; Lindenmayer, D. B. and R. F. Noss. 2006. Salvage logging, ecosystem processes, and biodiversity conservation. Conservation Biology 20:949-958.

[40] California Native Plant Society (CNPS). 2017. Herbicide Use on National Forest Lands in California (accessed June 23, 2017).

[41] Alfaro, R.I. et al. 2014. The role of forest genetic resources in responding to biotic and abiotic factors in the context of anthropogenic climate change. Forest Ecology and Management 333: 76-87.

[42] Millar, C.I. et al. 2007. Response of high-elevation limber pine (*Pinus flexilis*) to multiyear droughts and 20th-century warming, Sierra Nevada, California, USA. Canadian Journal of Forest Research 37: 2508-2520; Millar, C.I. et al. 2012. Forest mortality in high-elevation whitebark pine (*Pinus albicaulis*) forests of eastern California, USA; influence of environmental context, bark beetles, climatic water deficit, and warming. Canadian Journal of Forest Research 41: 749-765; Knapp, P.A. et al. 2013. Mountain pine beetle selectivity in old-growth ponderosa pine forests, Montana, USA. Ecology and Evolution 3: 1141-1148.

encourages practices that will reduce forest resilience and increase greenhouse gas emissions in the state.

In recommendation F-4, the Forest chapter promotes harvesting forest biomass and burning it in bioenergy facilities, and expanding California's wood products market, including "expanded and new markets for products such as cross-laminated timber and other engineered mass timber, biochar, and other soil amendments, and liquid biofuels."[43] The chapter provides no science-based rationale for why these practices would increase forest resilience to climate change.

This section also suggests that these practices will "minimize net greenhouse gas emissions."[44] However, a large body of scientific studies, detailed below, indicates that biomass combustion is extremely carbon-intensive, and that mechanical thinning paired with biomass burning for energy increases carbon emissions and creates a carbon debt.

A. Burning woody biomass is more carbon-intensive than burning fossil fuels.

Woody biomass combustion is not carbon-neutral as acknowledged by numerous scientific studies (see, e.g., Brandão et al. 2013, Repo 2010, Searchinger 2009),[45] the Intergovernmental Panel on Climate Change (IPCC),[46] and the EPA's science advisors.[47] The combustion of wood for energy instantaneously releases virtually all of the carbon in the wood to the atmosphere as CO_2. Burning wood for energy is typically less efficient, and thus far more carbon-intensive per unit of energy produced, than burning fossil fuels (even coal). Measured at the stack, biomass combustion produces significantly more CO_2 per megawatt-hour than fossil fuel combustion. A large biomass-fueled boiler may have an emissions rate far in excess of 3,000

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[43] Plan at 92.
[44] Plan at 92.
[45] Brandão, M. et al. 2013. Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. Int'l J. Life Cycle Assess 18: 230-240; Repo, A. et al. 2010. Indirect carbon dioxide emissions from producing bioenergy from forest harvest residues. Global Change Biology Bioenergy 3: 107-115; Searchinger, T.D. et al. 2009. Fixing a critical climate accounting error. Science 326: 527-528.
[46] IPCC Task Force on National Greenhouse Gas Inventories, Frequently Asked Questions, at http://www.ipcc-nggip.iges.or.jp/faq/faq.html (last visited March 16, 2017) (Q2-10) ("The IPCC Guidelines do not automatically consider biomass used for energy as 'carbon neutral,' even if the biomass is thought to be produced sustainably . . . . [T]he IPCC approach of not including [CO_2 emissions from the use of bioenergy] in the Energy Sector total should not be interpreted as a conclusion about the sustainability or carbon neutrality of bioenergy.").
[47] U.S. EPA, Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources 11-12 (Sept. 2011) ("The IPCC . . . eschewed any statements indicating that its decision to account for biomass CO_2 emissions in the Land-Use Sector rather than the Energy Sector was intended to signal that bioenergy truly has no impacton atmospheric CO_2 concentrations."); see also Deferral for CO_2 Emissions from Bioenergy and Other Biogenic Sources Under the Prevention of Significant Deterioration (PSD) and Title V Programs, 76 Fed. Reg. 43,490, 43,498 (July 20, 2011); Science Advisory Board Review of EPA's Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources 7 (Sept. 28, 2012) at 3.

lbs CO_2 per MWh.[48] Smaller-scale facilities using gasification technology are similarly carbon-intensive; the Cabin Creek bioenergy project recently approved by Placer County would have an emissions rate of more than 3,300 lbs CO_2/MWh.[49] By way of comparison, California's 2012 baseline emissions rate from the electric power sector was 954 lbs CO_2 per MWh.[50] As one recent scientific article noted, "[t]he fact that combustion of biomass generally generates more CO_2 emissions to produce a unit of energy than the combustion of fossil fuels increases the difficulty of achieving the goal of reducing GHG emissions by using woody biomass in the short term."[51] Put more directly, replacing California grid electricity with biomass electricity likely more than *triples* smokestack CO_2 emissions. Thus, measured at the smokestack, replacing fossil fuels with biomass actually *increases* CO_2 emissions.[52] One recent study found that the climate impact per unit of CO_2 emitted seems to be even higher for the combustion of slow-growing biomass than for the combustion of fossil carbon in a 100-year time frame.[53] Thus the warming effect from biogenic CO_2 can continue for decades or even centuries depending on the "feedstock."

In addition to producing large amounts of CO_2, biomass energy generation can result in significant emissions of other pollutants that worsen climate change and harm human health,

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[48] The Central Power and Lime facility in Florida, for example, is a former coal-fired facility recently permitted to convert to a 70-80 MW biomass-fueled power plant. According to permit application materials, the converted facility would consume the equivalent of 11,381,200 MMBtu of wood fuel per year. *See* Golder Assoc. 2012. Air Construction Permit Application: Florida Crushed Stone Company Brooksville South Cement Plant's Steam Electric Generating Plant, Hernando County Table 4-1 (Sept. 2011). Using the default emissions factor of 93.8 kg/MMBtu CO_2 found in 40 C.F.R. Part 98, and conservatively assuming both 8,760 hours per year of operation and electrical output at the maximum 80 MW nameplate capacity, the facility would produce about 3,350 lbs/MWh CO_2. If the plant were to produce only 70 MW of electricity, the CO_2 emissions rate would exceed 3,800 lbs/MWh. If such a facility were dispatched to replace one MWh of fossil-fuel fired generation with one MWh of biomass generation, the facility's elevated emissions rate would also result in proportionately higher emissions on a mass basis.

[49] Ascent Environmental. 2012. Cabin Creek Biomass Facility Project Draft Environmental Impact Report, App. D (July 27, 2012) (describing 2 MW gasification plant with estimated combustion emissions of 26,526 tonnes CO_2e/yr and generating 17,520 MWh/yr of electricity, resulting in an emissions rate of 3,338 lbs CO2e/MWh).

[50] See Energy and Environment Daily, Clean Power Plan Hub, at http://www.eenews.net/interactive/clean_power_plan/states/california (visited May 18, 2016).

[51] Bird, D.N. et al. 2011. Zero, one, or in between: evaluation of alternative national and entity-level accounting for bioenergy. Global Change Biology Bioenergy 4: 576-587.

[52] Typical CO_2 emission rates for facilities:
Gas combined cycle 883 lb CO_2/MWh
Gas steam turbine 1,218 lb CO_2/MWh
Coal steam turbine 2,086 lb/CO_2/MWh
Biomass steam turbine 3,029 lb CO_2/MWh
Sources: EIA, Electric Power Annual, 2009: Carbon Dioxide Uncontrolled Emission Factors. Efficiency values used to calculate emissions from fossil fuel facilities calculated using EIA heat rate data. (http://www.eia.gov/cneaf/electricity/epa/epat5p4.html); biopower efficiency value is 24%, a standard industry value.

[53] Holtsmark, B. 2013. The outcome is in the assumptions: analyzing the effects on atmospheric CO_2 levels of increased use of bioenergy from forest biomass. Global Change Biology Bioenergy 5: 467-473.

including nitrogen oxides, carbon monoxide, particulate matter, and black carbon. Many biomass emissions can exceed those of coal-fired power plants even after application of best available control technology. [54]

B. Even if harvested biomass is substituted for fossil fuels, it can be decades to centuries before the harvested forest achieves the same CO_2 reductions that could be achieved by leaving the forest unharvested.

Biomass and fossil CO_2 are indistinguishable in terms of their atmospheric forcing effects.[55] Claims about the purported climate benefits of biomass energy thus turn entirely on "net" carbon cycle effects, particularly the possibility that new forest growth will resequester carbon emitted from combustion, and/or the possibility that biomass combustion might "avoid" emissions that would otherwise occur. Multiple studies have shown that it can take a very long time to discharge the "carbon debt" associated with bioenergy production, even where fossil fuel displacement is assumed, and even where "waste" materials like timber harvest residuals are used for fuel.[56] Thus, even if harvested biomass is substituted for fossil fuels, it can be decades or centuries before the harvested forest achieves the same CO_2 reductions that could be achieved by leaving the forest unharvested (depending on harvest intensity, frequency, and forest characteristics).[57] One study, using realistic assumptions about initially increased and subsequently repeated bioenergy harvests of woody biomass, concluded that the resulting atmospheric emissions increase may even be permanent.[58]

Hudiburg et al. (2011) examined forest carbon responses to three different levels of fuel reduction treatments in 19 West Coast ecoregions containing 80 different forest types and

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[54] Booth, Mary S. 2014. Trees, Trash and Toxics: How biomass energy has become the new coal. Partnership for Policy Integrity (April 2, 2014). Available at: pfpi.net/wp-content/uploads/2014/04/PFPI-Biomass-is-the-New-Coal-April-2-2014.pdf (visited March 16, 2017).

[55] U.S. EPA Science Advisory Board. 2012. Science Advisory Board Review of EPA's Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources 7 (Sept. 28, 2012); *see also Center for Biological Diversity, et al. v. EPA*, 722 F.3d 401, 406 (D.C. Cir. 2013) ("In layman's terms, the atmosphere makes no distinction between carbon dioxide emitted by biogenic and fossil-fuel sources").

[56] *See, e.g.*, Mitchell, S.R. et al. 2012. Carbon debt and carbon sequestration parity in forest bioenergy production. Global Change Biology Bioenergy 4: 818-827; Schulze, E.-D. et al. 2012. Large-scale bioenergy from additional harvest of forest biomass is neither sustainable nor greenhouse gas neutral. Global Change Biology Bioenergy 4: 611-616; McKechnie, J. et al. 2011. Forest bioenergy or forest carbon? Assessing trade-offs in greenhouse gas mitigation with wood-based fuels. Environ. Sci. Technol. 45: 789-795; Repo, A. et al. 2010. Indirect carbon dioxide emissions from producing bioenergy from forest harvest residues. Global Change Biology Bioenergy 3: 107-115; Gunn, J., et al., Manomet Center for Conservation Sciences. 2010. Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources.

[57] Searchinger, T.D. et al. 2009. Fixing a Critical Climate Accounting Error. Science 326: 527; Hudiburg, T.W. et al. 2011. Regional carbon dioxide implications of forest bioenergy production. Nature Climate Change 1: 419-423; Campbell, J.L. et al. 2012. Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions? Frontiers in Ecology and the Environment 10: 83-90; Mitchell, S.R. et al. 2012.

[58] Holtsmark, B. 2013. The outcome is in the assumptions: analyzing the effects on atmospheric CO_2 levels of increased use of bioenergy from forest biomass. Global Change Biology Bioenergy 5: 467-473.

different fire regimes.[59] In nearly all forest types, intensive harvest for bioenergy production resulted in net carbon emissions to the atmosphere, at least over the 20-year time frame of the study. Even lighter-touch fire prevention scenarios produced net carbon emissions in most ecoregions. The study demonstrated that across a wide range of ecosystems, thinning for fuels reduction and using the by-products for bioenergy increases CO_2 concentrations, at least in the short term.

A review by Schulze et al. (2012) concluded that "large-scale production from forest biomass is neither sustainable nor GHG neutral. [A]n increase in biomass harvest would result in younger forests, lower biomass pools, depleted soil nutrient stocks and a loss of other ecosystem functions. Large-scale woody bioenergy is likely to miss its main objective, i.e. to reduce greenhouse gas (GHG) emissions, because it would result in a reduction of biomass pools that may take decades to centuries to be paid back by fossil fuel substitution, if paid back at all."[60]

C. Forest management policies that promote fuels reduction and biomass burning for energy are inconsistent with achieving California climate goals.

The Governor's Executive Order B-30-15 and Senate Bill 32 establish a mid-term greenhouse gas emissions reduction target for California of 40 percent below 1990 levels by 2030. Executive Order S-3-05 calls for the state to reduce emissions levels by 80 percent below 1990 levels by 2050. These targets require increasingly steep reductions in emissions over the next three decades. Yet the science shows this is precisely the time period during which the carbon emitted from forest harvest practices and biomass burning will increase atmospheric CO_2 levels. At a time when we need to reduce emissions dramatically in the short term and keep them down, California forest policy should not be promoting intensive thinning and biomass burning that will exacerbate climate change.

The chapter also asserts that California should expand wood products manufacturing because California's wood consumption is higher than its wood production. We recommend that the chapter encourage reductions in wood consumption in California, rather than increasing wood extraction from the forests, so that trees can stay in the forest ecosystem naturally sequestering and storing carbon. Expanding logging and wood products manufacturing facilities, as the chapter recommends, will only increase the pressure to keep removing more and more wood from California's forests, which would be counterproductive from a carbon and forest health perspective.

V. Recommendation F-5 ("implement sustainable forest management and working forests for the overall health and protection of forested watersheds") is based on scientifically unsupported assertions.

The rationale for recommendation F-5 asserts that "post-fire reforestation and forest health activities, such as commercial timber harvesting and thinning, can improve watershed

[59] Hudiburg, T.W. et al. 2011. Regional carbon dioxide implications of forest bioenergy production. Nature Climate Change 1: 419-423.
[60] Schulze et al. 2012.

health and benefit water resources,"[61] which is a highly consequential claim that is not supported by the best available science. The recommendations for thinning and logging for watershed health and water supplies should be removed.

With respect to effects on water resources, a 2008 consensus panel report on forest hydrology by the National Research Council concluded that it is "impractical to manage forests for increased water" because timber harvest does not significantly improve water yields and can damage forest and aquatic ecosystems:

> There is little evidence that timber harvest can produce sustained increase in water yield over large areas.[62]
>
> Although in principle forest harvest can increase water yield, in practice a number of factors make it impractical to manage forests for increased water. Water yield increases from vegetation removal are often small and unsustainable, and timber harvest to augment water yield may diminish water quality. Increases in water yield tend to occur at wet, not dry, times of the year, and tend to be much smaller in relatively dry years. In addition, harvesting enough area to achieve a sustainable increase in water yield will have potential effects on wildlife fisheries and aquatic ecosystems.[63]

Similarly, a scientific literature review by Rhodes and Frissell (2015), that synthesized the findings of 230 studies and reports, concluded that timber harvest to increase water yield in the Sierra Nevada has significant enduring environmental costs and limited utility for water supply.[64] Specifically, the review concluded:

> • Water yield increases are highly variable and not amenable to accurate prediction solely as a function of the amount of forest removed. However, aggregate data indicate that, on average, only very modest increases in water yield can be expected.
> • At the scale of major watersheds which supply water, any actual water yield increase from forest removal is likely to be too small to verify via field flow measurement.
> • Increases are very strongly affected by seasonal precipitation. Flow increases are most unlikely and smallest during dry years and during dry seasons. Thus, the approach has very nominal potential to improve water yield during droughts. For the same reasons, the approach is unlikely to provide additional water during dry seasons when demand is high relative to supply.

[61] Plan at 94.
[62] National Research Council (NRC). 2008. Hydrologic Effects of a Changing Forest Landscape. National Academies Press, Washington, DC. at 62.
[63] *Id.* at 73.
[64] Rhodes, J.J. and C.A. Frissell. 2015. The High Costs and Low Benefits of Attempting to Increase Water Yield by Forest Removal in the Sierra Nevada. 108 pp.

• Increases are typically greatest during the period of highest runoff and during the wettest years. Due to this timing, any realized increases may have negligible benefits for water supply, while contributing to increased flooding.
• Any increases in water yield from forest removal are diminished by transmission losses and storage losses, reducing any increase in downstream water supply.
• Increased water yield in response to forest removal is transient. Any increases are erased by vegetative regrowth within several years after forest removal. In effect, forest removal promotes regrowth that exacerbates water demand by second-growth vegetation.
• In the absence of continued removal, forest removal contributes to net reductions in low flows in subsequent decades, exacerbating water supply problems when demand is typically highest.
• The maintenance of potential increases in water yield would require clearing of large percentage of forests at high frequency, on the order of 25% of watershed area every 10 years. This frequency and magnitude of forest removal would incur significant fiscal, logistical, and environmental costs.[65]

The rationale for recommendation F-5 also employs a problematic double standard of discussing wildfire only in terms of purported harms to watersheds (through erosion),[66] while discussing logging only in terms of purported benefits to watersheds.[67] In fact, as numerous studies have documented, logging and logging roads themselves cause persistent harm to watersheds.[68] The chapter's claim that post-fire salvage logging "can improve watershed health"[69] is particularly troubling since the significant ecological harms of post-fire salvage logging have been well established by the scientific literature.[70] The section also makes no attempt to compare the short-term effects of erosion following fire with the greater, more

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[65] *Id.* at iii.
[66] Plan at 94: "Soil loss following high severity fire negatively affects tree growth and carbon sequestration, and can be detrimental to watershed health. High sediment loads, conveyed during the high-flow events typical of California's precipitation regime, typically follow large, high-severity fires for a number of years. This sediment and debris can reduce reservoir capacity, increase water turbidity, interfere with other critical infrastructure, and negatively affect riparian habitat."
[67] Plan at 94: "Post-fire reforestation and forest health activities, such as commercial timber harvesting and thinning, can improve watershed health and benefit water resources. Forest management helps to reduce the need to remove silt and debris from reservoirs and recharge basins, make more space for water supply storage and hydropower generation capacity, and increase the economic value of these activities."
[68] Trombulak, S.C. and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology14: 18-30; Gucinski, H. et al. 2001. Forest roads: a synthesis of scientific information, USFS PNW GTR-509. USFS Pacific Northwest Research Station, Portland.
[69] Plan at 94: "Post-fire…commercial timber harvesting and thinning, can improve watershed health"
[70] As summarized by Lindenmayer and Noss (2006), salvage logging can "reduce or eliminate biological legacies (e.g., burned trees, logs), modify rare post-disturbance habitats, influence populations, alter community composition, impair natural vegetation recovery, facilitate the colonization of invasive species, alter soil properties and nutrient levels, increase erosion, modify hydrological regimes and aquatic ecosystems, and alter patterns of landscape heterogeneity….we believe new terminology is needed. The word salvage implies that something is being saved or recovered, whereas from an ecological perspective this is rarely the case," at 949.

persistent damage to watersheds caused by logging and logging roads, including increases in erosion and sedimentation and degradation of water quality and aquatic habitats, nor does it acknowledge the long-term damage from grazing.

We support this section's focus on meadow restoration and sub-recommendation F-5.3 ("restore 10,000 acres of mountain meadow habitat on non-forest lands in key locations; work with the U.S. Forest Service to restore mountain meadow habitat on federally managed lands"). We also strongly recommend adding three science-based management measures that have been shown to improve watershed health, benefit water supplies by improving low flow and water quality conditions at a relatively low economic cost, and which are likely to increase forest resilience to climate change: (1) the reduction or cessation of livestock grazing near streams and meadows in the headwaters of the Sierra Nevada; (2) reductions in the extensive and expensive network of logging roads in Sierra Nevada national forests; and (3) the restoration of beaver populations in the Sierra Nevada.[71]

VI. Recommendation F-6 ("foster fire-adapted communities through local planning and fire preparedness") should focus on reducing ignitability of structures and protecting defensible space immediately around homes.

We support the creation of fire-adapted communities in forested areas. However, we recommend that adaptation actions focus on supporting home safety work in the defensible space zone immediately surrounding homes. Scientific studies indicate that the only effective way to protect structures from fire is to reduce the ignitability of the structure itself (e.g., fireproof roofing, leaf gutter guards) and the immediate surroundings within about 100 feet from each home, e.g., through thinning of brush and small trees adjacent to the homes in the defensible space zone (Cohen 2000, Cohen and Stratton 2008, Gibbons et al. 2012).[72] Only 3% of Forest Service "fuels reduction" projects are conducted within the WUI, adjacent to communities – and much of that 3% is well over 100 feet from homes (Schoennagel et al. 2009).[73] Efforts to promote large-scale thinning in areas far away from buildings are often wasteful, expensive, inefficient, carbon-releasing, ecologically-damaging, and relatively ineffective, compared to efforts that focus on buildings and the defensible space in their immediate vicinity (Scott et al. 2016).[74] Thus, the Forest chapter recommendations will be more cost-efficient and most effective for protecting communities and forest health if they focus on home safety work in the defensible space zone.

[71] See Rhodes, J.J. and C.A. Frissell. 2015.

[72] Cohen, J.D. 2000. Preventing disaster: home ignitability in the Wildland-Urban Interface. Journal of Forestry 98: 15-21; Cohen, J.D., and R.D. Stratton. 2008. Home destruction examination: Grass Valley Fire. U.S. Forest Service Technical Paper R5-TP-026b. U.S. Forest Service, Region 5, Vallejo, CA; Gibbons, P. et al. 2012. Land management practices associated with house loss in wildfires. PLoS ONE 7: e29212.

[73] Schoennagel, T. et al. 2009. Implementation of National Fire Plan treatments near the wildland-urban interface in the western United States. PNAS 106: 10706-10711.

[74] Scott, J.H. et al. 2016. Examining alternative fuel management strategies and the relative contribution of National Forest System land to wildfire risk to adjacent homes – A pilot assessment on the Sierra National Forest, California, USA. Forest Ecology and Management 362: 29-37.

VII. The Resources Agency cannot approve the Plan without first complying with CEQA.

The Plan is clearly a "project" for purposes of California Environmental Quality Act ("CEQA"), Public Resources Code § 21000 et seq., and the CEQA Guidelines, title 14, California Code of Regulations, § 15000 et seq. To our knowledge, however, neither the Resources Agency nor any other agency has undertaken to comply with CEQA in connection with preparation and review of the Plan. Accordingly, no agency may approve, or otherwise take any steps toward implementation of, the Plan until CEQA compliance is completed.

A. The Plan is a "project" for purposes of CEQA

1. Legal Background

The Legislature enacted CEQA to "[e]nsure that the long-term protection of the environment shall be the guiding criterion in public decisions." *No Oil, Inc. v. City of Los Angeles*, 13 Cal. 3d 68, 74 (1974). The Supreme Court has repeatedly held that CEQA must be interpreted to "afford the fullest possible protection to the environment." *Wildlife Alive v. Chickering*, 18 Cal. 3d 190, 206 (1976) (quotation omitted).

CEQA also serves "to demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implications of its action." *Laurel Heights Improvement Ass'n v. Regents of Univ. of Cal.*, 47 Cal. 3d 376, 392 (1988) ("*Laurel Heights I*"). If CEQA is "scrupulously followed," the public will know the basis for the agency's action and "being duly informed, can respond accordingly to action with which it disagrees." *Id.* Thus, CEQA "protects not only the environment but also informed self-government." *Id.*

CEQA applies to all "discretionary projects proposed to be carried out or approved by public agencies." Pub. Res. Code § 21080(a). Accordingly, before taking any action, a public agency must conduct a "preliminary review" to determine whether the action is a "project" subject to CEQA. *See Muzzy Ranch Co. v. Solano County Airport Land Use Comm'n*, 41 Cal. 4th 372, 380 (2007).

A "project" is "the whole of an action" directly undertaken, supported, or authorized by a public agency "which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment." Pub. Res. Code § 21065; CEQA Guidelines § 15378(a). Under CEQA, "the term 'project' refers to the underlying activity and not the governmental approval process." *California Unions for Reliable Energy v. Mojave Desert Air Quality Mgmt. Dist.*, 178 Cal. App. 4th 1225, 1241 (2009) (quoting *Orinda Ass'n v. Bd. of Supervisors*, 182 Cal. App. 3d 1145, 1171-72 (1986)). The definition of "project" is "given a broad interpretation in order to maximize protection of the environment." *Lighthouse Field Beach Rescue v. City of Santa Cruz*, 131 Cal. App. 4th 1170, 1180 (2005) (internal quotation omitted). A project need not even involve tangible physical activity so long as the agency's discretionary action has the potential to lead to either a direct or a reasonably foreseeable indirect physical change in the environment. *See Communities for a Better Env't v. Cal. Res. Agency*, 103 Cal. App. 4th 98, 126 (2002) ("Governmental organizational activities, such as annexation approvals and school district reorganizations, which constitute an essential step culminating in an environmental effect are 'projects' within the scope of CEQA."); *see also, e.g.*, *Muzzy Ranch*, 41 Cal. 4th at 382-83; *Fullerton Joint Union High Sch. Dist. v. State Bd. of Educ.*, 32 Cal. 3d 779, 796-97 (1982); *Bozung v. Local Agency Formation Comm'n*, 13 Cal. 3d 263, 277-81 (1975).

CEQA requires the preparation of environmental review documents "as early as feasible in the planning process to enable environmental considerations to influence project program and design and yet late enough to provide meaningful information for environmental assessment." *Laurel Heights I*, 47 Cal.3d at 395; *see also* CEQA Guidelines § 15004(b). The purpose of CEQA is to provide decision-makers and the public with environmental information before decisions are made, not after. As the California Supreme Court observed in *Laurel Heights I*, "[i]f post-approval environmental review were allowed, [CEQA analyses] would likely become nothing more than *post hoc* rationalizations to support action already taken. We have expressly condemned this [practice]." 47 Cal. 3d at 394 (citation omitted).

Moreover, "public agencies shall not undertake actions concerning the proposed public project that would have a significant adverse effect or limit the choice of alternatives or mitigation measures, before completion of CEQA compliance." CEQA Guidelines § 15004(b)(2). In particular, an agency shall not "take any action which gives impetus to a planned or foreseeable project in a manner that forecloses alternatives or mitigation measures that would ordinarily be part of CEQA review of that public project." CEQA Guidelines § 15004(b)(2)(B). CEQA review must be completed while environmental considerations still can inform CalFIRE's (or any other agency's) decision, and *before* any agency takes any step that forecloses any potential mitigation measures or alternatives. *Laurel Heights I*, 47 Cal.3d at 394-95; CEQA Guidelines § 15004(b)(2)(B). It does not matter for purposes of CEQA that other public agencies also may need to render some later decision with regard to Plan implementation. *See Fullerton Joint Union High Sch. Dist. v. State Bd. of Educ.*, 32 Cal. 3d 779, 795 (1982). Rather, environmental review must accompany a public agency's *earliest* commitment to a course of action, taking into account bureaucratic momentum; "CEQA review may not always be postponed until the last governmental step is taken." *Save Tara v. City of West Hollywood*, 45 Cal. 4th 116, 134-35 (2008).

2. The Plan is a discretionary "project" pursuant to CEQA.

Any action to approve or otherwise implement the Plan would clearly be "discretionary" for purposes of CEQA. CEQA applies to projects of a discretionary, rather than a ministerial, character. Pub. Res. Code § 21080. A discretionary action is one that "requires the exercise of judgment or deliberation" on the part of a public agency in deciding whether "to approve or disapprove a particular activity." CEQA Guidelines § 15357; *see also Mountain Lion Foundation v. Cal. Fish & Game Comm'n*, 16 Cal. 4th 105, 112 (1997) (defining discretionary projects as projects "subject to 'judgmental controls,' i.e., where the agency can use its judgment in deciding whether and how to carry out the project"). A "ministerial" decision, in contrast, "involves only the use of fixed standards or objective measurements" without any exercise of judgment. CEQA Guidelines § 15369 (citing "automobile registrations, dog licenses, and marriage licenses" as examples). Doubts should be resolved in favor of a finding that decisions are discretionary, and where a project is of a hybrid discretionary and ministerial character, CEQA applies even if the project is largely ministerial. CEQA Guidelines § 15268(d); *Friends of Westwood v. City of L.A.* 191 Cal. App. 3d 259, 271-72 (1987).

Here, the Resources Agency or another agency would necessarily exercise a great deal of discretionary judgment in approving or carrying out the Plan. Its significant flaws notwithstanding, the Plan purports to review applicable science, weigh evidence, and propose a series of concrete actions to achieve particular conditions. These are hallmarks of discretionary decision-making. *See, e.g.*, *Mountain Lion Foundation*, 16 Cal. 4th at 115, 118.

The Plan also clearly may cause both direct and reasonably foreseeable indirect changes in the physical environment. Pub. Res. Code § 21065; CEQA Guidelines § 15378(a). Indeed, as discussed above, many of the Plan's recommendations would increase logging and other forest management "treatments." The plain purpose of these treatments would be to alter the physical condition of the forest. Beyond this purpose, implementation of the Plan may foreseeably cause other environmental impacts discussed above, including damage to habitat, water quality, and soil resources from logging, as well as increased greenhouse gas emissions from removal of forest carbon stocks, bioenergy and biofuels production, and wood products processing. The Plan thus meets CEQA's definition of a "project," and it may not be approved or carried out until environmental analysis in accordance with CEQA is complete.

B. There is no evidence that the Resources Agency or any other agency has complied with CEQA in connection with the Plan.

There is no indication that the Resources Agency or any other public agency has undertaken CEQA compliance in connection with the Plan. Nothing on the Resources Agency's "Safeguarding California Plan" website—where the Plan is available—discusses CEQA compliance.[75] No CEQA documents are posted on the site. A search of the CEQANet database maintained by the Office of Planning and Research did not reveal any CEQA notices or other documents posted in the last two years regarding the "Safeguarding California" plan.[76]

C. CalFIRE's failure to conduct CEQA analysis is prejudicial.

As discussed above, CEQA's core purposes include ensuring that both decision-makers and the public have detailed information about the environmental effects of proposed projects in hand before decisions affecting the environment are made. CEQA also requires that a range of reasonable alternatives to a proposed action be considered, and that significant environmental effects be avoided or lessened to the extent feasible, in connection with any approved project.

The Resources Agency's failure to conduct CEQA review of the Plan thwarts these core purposes and requirements. For example, CEQA requires the Resources Agency (or another lead agency) to disclose and analyze all potentially significant environmental effects of the Plan, and to adopt mitigation measures to avoid or reduce those effects, before approving or carrying out

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[75] California Natural Resources Agency, Safeguarding California Plan: 2017 Update—California's Climate Adaptation Strategy Draft Release and Workshop Schedule, at http://resources.ca.gov/climate/safeguarding/ (visited June 23, 2017).

[76] Searches for keywords such as "adaptation" and "resilience" also revealed no CEQA documents related to this Plan within the last two years.

the Plan. Pub. Res. Code §§ 21002, 21002.1, 21081. CEQA also requires the Resources Agency to consider alternatives to the approach proposed in the Plan, including but not limited to alternatives discussed in other sections of these comments. Because the Resources Agency's failure to complete CEQA analysis has prevented not only disclosure and analysis of potentially significant impacts, but also consideration of mitigation measures and alternatives, any steps to approve or carry out any aspect of the Plan absent CEQA compliance would be unlawful and would constitute a prejudicial abuse of discretion.

VII. Conclusion

Thank you for your consideration of these comments. We are submitting pdfs of all cited references on a compact disk sent by overnight Fed-Ex. Please contact us if you have any questions about these recommendations. We look forward to discussing these comments with you.

Sincerely,

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