EPA RESPONSE TO THE EXTERNAL LETTER PEER REVIEW REPORT ON COMPARATIVE ASSESSMENT OF THE IMPACTS OF PRESCRIBED FIRE VERSUS WILDFIRE (CAIF): A CASE STUDY IN THE WESTERN U.S.

(2021)

Center for Public Health and Environmental Assessment
Office of Research and Development
U.S. Environmental Protection Agency
Research Triangle Park, NC

Overview

In January 2020, the Wildland Fire Leadership Council's (WFLC) requested that the U.S. Environmental Protection Agency (EPA) conduct an assessment of the health impacts of prescribed fire versus wildfire. Building off this request, EPA actively engaged with the U.S. Forest Service (USFS), Department of the Interior (DOI) (including the bureaus), and National Institute of Standards and Technology (NIST) to plan and develop the CAIF report, and in the process foster interagency connections that previously did not exist. These extensive interactions and discussions have led to a critical framework to not only discuss different fire management strategies, but also a novel modeling component that allows for a quantitative comparison of the air quality and health impacts attributed to smoke from each. The following provides a brief synopsis of what the report will encompass and the modeling efforts taking place.

While the main goal of the CAIF report is to conduct a quantitative assessment of the air quality and health impacts when comparing different fire management strategies, this report also provides an opportunity to have an integrated discussion of topics ranging from land management practices to air quality monitoring issues to health and ecological impacts of smoke exposure, which previously have not been discussed within the context of one report on fire. The interagency group of over 50 expert scientists and the ensuing discussions have resulted in the development of a report that will encompass the following topics:

- A conceptual framework and model for evaluating different fire management strategies.
- Background information on different fire regimes, including land management practices, and the associated effects (both beneficial and detrimental) due to fire.
- A discussion of air quality monitoring as it pertains to prescribed fire and wildfires including current monitoring capabilities and resources available to obtain information on air quality measurements and pollutant concentrations.
- Characterization of epidemiologic evidence of health effects, specifically within the U.S., attributed to wildfire smoke exposures along with quantitative information on public health measures that are currently used and could be instituted to reduce individual and population-level exposures to wildfire smoke.
- Characterization of ecological effects attributed to wildfire smoke.
- Broad overview of the direct fire effects of wildfire with a focus on firefighter health and safety and societal effects (i.e., economic and welfare effects).

The qualitative discussions presented above set the stage for the main component of the assessment, which is a modeling analysis focusing on case study wildfires in the Western U.S. The initial modeling effort, which focuses on a small wildfire (~3,000 acres) that occurred in Oregon (Timber Crater 6 [TC6] Fire – July 21-26, 2018), allowed for the modeling framework to be established and ultimately the examination of a larger case study wildfire (i.e., the Rough Fire which occurred in California – July 31 – October 1, 2015 and burned ~150,000 acres). Both wildfires were selected because they are representative of interagency wildfires that occurred on federal land. The TC6 Fire was selected because there is extensive data on land management, fuel treatment, prescribed fire, and wildfire activity; whereas the Rough Fire was selected because it represented a larger wildfire, to allow for a scaling up of the modeling approach developed for the TC6 Fire. For both case studies, hypothetical

scenarios assuming different land management practices that could have resulted in smaller or larger actual wildfires were developed to compare the smoke and associated health impacts attributed to different land management strategies, including prescribed fire, in comparison to the actual case study wildfires.

The result of the modeling effort is estimated concentrations of fine particles ($PM_{2.5}$) and ozone from a photochemical transport model for each actual and hypothetical wildfire scenario, and prescribed fires. This air quality data serves as an input to EPA's Environmental Benefit Mapping and Analysis Program – Community Edition (BenMAP – CE), which estimates the potential health and economic impacts attributed to changes in air quality for each case study wildfire, hypothetical scenarios, and prescribed fires. In addition, the quantitative information obtained from evaluating peer-reviewed studies focusing on different actions to mitigate population exposures to wildfire smoke will be used to provide a crude estimation of the potential implications of the population engaging in exposure reduction actions based on public health messaging.

The report concludes with an integrated synthesis that ties together the common themes of the report and presents the overall conclusions of the assessment. Additionally, it highlights limitations of the analysis, and research and data needs to further assess the smoke impacts of prescribed and wildfire fire in the future. Lastly, the integrated synthesis lays the foundation for discussions on future directions that could be explored to build upon the work initiated in this assessment. Overall, the potential future impact and stakeholders reached through this report is expected to be amplified due to the interagency and transdisciplinary approach and considerations throughout this effort.

Letter Peer Review

The CAIF Report underwent an external, contractor led letter peer review in April 2021. This report lists the comments provided by the 8 subject matter experts that reviewed the draft CAIF Report and the U.S. EPA's response to those comments. The 8 subject matter experts that reviewed the draft CAIF Report were the following:

- James L. Crooks, Ph.D.; National Jewish Health and Colorado School of Public Health.
- Joseph Wiman Domitrovich, Ph.D.; USDA, Forest Service Office of Work and Environmental Performance, and Forest Service National Technology and Development Program.
- Molly E. Hunter, Ph.D.; University of Arizona.
- Benjamin A. Jones, Ph.D.; University of New Mexico, University of Oklahoma, Editorial Council for *Journal of Environmental Economics and Management*.
- Loretta J. Mickley, Ph.D.; Harvard University, Conservation Law Foundation Board of Trustees.
- Sean M. Raffuse, M.S.; University of California Davis, Air Quality Research Center.
- Matthew J. Strickland, Ph.D.; University of Nevada-Reno.
- Alan F. Talhelm, Ph.D.; California Air Resources Board, Associate Editor for *Fire* (Research Journal)

The comments of each reviewer were blinded and as such comments from each individual reviewer are denoted by a number and not the name of the reviewer that provided the comment in the tables below.

Charge Questions

Overarching Charge Question

1. Please comment on the overall organization and clarity of the report. Please identify its overall strengths and weaknesses.

Chapter Specific Charge Questions

If a question is beyond your technical expertise, please skip it.

1. Chapter 1 introduces this assessment including the rationale, approach, and goals of the report, along with the appropriate context in which to view the results. Please comment on the completeness of the introductory information. Are there any areas that are unclear, or would benefit from additional information to set the basis of the assessment? Please explain.

2. The structure of this assessment is described in the form of a conceptual framework in Chapter 2. The chapter is intended to set the stage for the remaining chapters and demonstrate how the individual components of the assessment fit together to inform the key questions regarding the air quality, health, and ecological effects of different fire management strategies. Please comment on whether the conceptual framework fully captures the components of different fire management strategies and the corresponding health impacts and damages. Are there specific components that should be added or removed from the framework? How well does the text support the overall framework? Please explain.

3. Chapter 3 outlines baseline forest conditions, defines different fire management strategies, and discusses the role of fire in ecosystems, specifically focusing on the ecosystem of the case study fire locations (i.e., Ponderosa Pine Ecosystems). Please comment on the completeness of this discussion and whether it forms an adequate introduction of the topics.

4. Current air quality monitoring capabilities, as they pertain to wildfire smoke, are a key resource for understanding the specific health effects associated with smoke exposures and are critical to evaluate the performance of air quality models in predicting air quality impacts from wildfires. Chapter 4 discusses current air quality monitoring capabilities for wildfire smoke and associated challenges. Are all relevant capabilities discussed, or is there anything that should be added? Are the strengths and weaknesses of the individual capabilities covered in sufficient detail? Does the presentation of information on monitoring capabilities help to characterize the confidence in the air quality and health and ecological impacts provided in the assessment? Please explain.

5. The main component of this assessment is a novel air quality modeling approach that allows for a comparison of the health impacts between different fire management strategies, discussed in Chapter 6. Chapter 5 outlines the modeling approach employed and the various assumptions and decisions made in the process of modeling both hypothetical fire management strategies as well as prescribed fire. Please comment on the overall modeling approach, specifically the characterization of fuel loads, emissions, and the application of the air quality models, and whether there are inherent limitations that have not been adequately captured within the chapter. Is the chapter clearly written in cohesive way to describe the exercise?

6. Chapter 6 encompasses two components of this report: (1) a discussion of the health effects attributed to wildfire smoke and potential actions that can be taken to reduce exposures to wildfire smoke; and (2) a discussion of the ecological effects of wildfire smoke. Please comment on the following:

- The health effects discussion focuses on U.S.-based epidemiologic studies to support the BenMAP – CE analysis discussed in Chapter 8. Please comment on whether the discussion on the health effects evidence, including the corresponding appendix table, adequately inform decisions on the studies that could be used to estimate health impacts in BenMAP – CE. Have any U.S.-based studies been excluded from the discussion that should be included?

- The discussion of actions that can be taken to reduce wildfire smoke exposure is aimed at supporting the development of sensitivity analyses in BenMAP – CE to estimate the potential reduction in $PM_{2.5}$ exposure from wildfire smoke that could be experienced due to specific actions by the public. Please comment on the adequacy of this discussion, the exposure reduction options characterized, and the overall conclusions of the section.

- The ecological impacts discussion focuses on those effects attributed to wildfire smoke exposure and deposition. Please comment on the ecological impacts highlighted and whether additional studies/citations should be considered within this section.

7. In fully characterizing the tradeoffs between prescribed fires and wildfires it is necessary to also characterize the non-smoke related damages associated with fire, including impacts on fire fighter health and safety, as well as some additional direct and indirect damages attributed to wildfire smoke. Please comment on the adequacy of these discussions. Are there additional citations or information needed to strengthen this summary? Are there other damages that should be included in this Chapter?

8. Chapter 8 conducts a BenMAP – CE analysis building off the information presented in the air quality modeling chapter (Chapter 5) and the health effects and exposure reduction sections of Chapter 6. Please comment on (1) the approach used to compare results between the different fire management strategies (2) the sensitivity analyses conducted, and (3) the presentation of results.

9. Chapter 9 consists of an integrated synthesis of the information presented within this report. Please comment on how well this chapter fully captures the breadth of this report. Are the various factors to consider in examining tradeoffs between the different fire management strategies adequately described? Does it appropriately highlight the strengths and limitations of the assessment, as well as key insights? Please explain.

Table 1. Review comments in response to Overarching Charge Question #1

Reviewer	Comment	Response
1	Overall, the report undertakes a rather ambitious task and makes incremental progress in our understanding of how wildfire smoke health impacts compare to prescribed fire (Rx fire) smoke health impacts. The report is generally thorough, though, it comes across as a bit too authoritative and matter of fact, when, in actuality, this is an area with many well-known knowledge and data gaps (and these gaps are evident in the modeling done in the report). I found the organization to be appropriate (with some exceptions, as described below, for example, the need for a section on studies that have specifically looked at Rx fire smoke health impacts) and the report is generally clear. There is some risk of the report simply being dismissed as a literature review of the wildfire and Rx fire literatures. The actual modeling and empirical analysis is relegated to a later chapter and seems almost secondary (and maybe this was the intention of the authors). While the literature review is helpful and will make a nice contribution, I'm not sure as to its policy relevance and I'm also not sure about this report's contribution to the larger literature in this area. The modeling analysis also has many limitations (and some of them are stated in the report), which makes it seem like an "add-on" at the last minute to a literature review report. Suggest that either the (weak) modeling analysis is dropped altogether, or, if it is kept, that it is beefed-up substantially, to, for example, include a much more formal benefit-cost analysis that at a minimum includes a study of intertemporal tradeoffs between smoke from Rx fires and smoke from wildfires. Discounting needs to be	Revisions were made to put each chapter in the proper context to convey why each is important and the order of chapters was revised to better reflect the qualitative nature of some chapters and the quantitative nature of others. The modeling component is the "main" component of the report and efforts were taken to make this clearer. As a point of clarification, prescribed fires were not modeled in the same year as the wildfire for both case studies. All prescribed fire activity, for only the TC6 fire was modeled in the same year because, as we note, detailed data was not available on the actual days in which prescribed fires occurred. Each prescribed fire was modeled as a singular event. While discounting of the value of damages that occur in future years is appropriate, there is no information available to determine the ex-ante difference in timing of prescribed fires and subsequent wildfires. For the purposes of this case study, we modeled the prescribed fires and wildfire scenarios as occuring in the same year. To demonstrate the potential impact on the dollar value of health damages, we have added a paragraph to Chapter 8 showing the impact of a delay of 5 or 10 years between the prescribed fire (assumed to occur in a current year) and a subsequent wildfire. These are not intended to be viewed as alternative estimates for the case study, but rather as an illustration of the impact of discounting.

Reviewer	Comment	Response
	included and costs/benefits cannot be crudely compared for an Rx fire occurring in the same year as the wildfire.	
1	I did enjoy reading the report (though I only carefully read the ES, Chapters 1-2, 6, and 9, but skimmed the other chapters; some of which are outside my area of expertise). I can't say that I learned much new material above and beyond my read of this literature over the last decade or so (which I follow closely). Again, the modeling analysis is intriguing, but crudely done with many assumptions made (some unfounded in my opinion, and see specific comments below). Perhaps it is "good enough", but I would push back some if asked to endorse the modeling analysis. The strength of this report is in the synthesis of the literature and the discussions in Ch.9 on next steps/future work/gaps in the literature.	As occurs with any modeling, expert judgment is employed. While the commenter may not agree with the exact approach, all assumptions are articulated within the report, and in many instances, decisions were based on data limitations.
1	The charge given was to "lead an assessment that would characterize and compare the impacts of wildland fires under different fire management strategies, including prescribed fire." Given this, focusing exclusively on smoke health impacts needs to be justified. The charge was much broader than smoke and health.	Text was revised to reflect the fact that we were only charged with examining smoke impacts, which is articulated in multiple places throughout the report.
1	p.ES-1, line 23: There is also an epidemiological literature on prescribed fire smoke health impacts, specifically, outside of wildfire smoke exposure. Both literatures should be included here.	We disagree with this comment. We reviewed the references provided by Reviewer 1, and as noted in Chapter 6, to date there is only one study conducted in the U.S. that specifically focused on the health effects of prescribed fire smoke. The studies referenced by Reviewer 1 represent assessments of the potential public health impacts of prescribed fire smoke which rely on health impact functions derived from studies of wildfire smoke, not prescribed fire smoke. They do not represent original research focusing specifically on examining the relationship between prescribed fire smoke and health.

Reviewer	Comment	Response
		Additionally, some references provided represent commentaries and not original research.
1	p.ES-1, lines 29-36: Clarify here if both the TC6 and Rough Fires occurred on lands that had been previously the location of prescribed burns. If Yes, how much is the overlap of wildfire with prescribed burn extent? How long ago did the Rx fire occur? If Rx fires didn't occur on lands burned by the TC6 and Rough Fires, then why were these fires selected?	This was an oversight in the ES. The text has been revised. Actual prescribed fires only occurred on the TC6 land, we explicitly state this in later chapters (e.g., Chapters 3 and 7), but did not clearly articulate this nuance in the ES. Detailed discussions in Chapter 7 convey the years of prescribed fire activity and the corresponding burn perimeters. For the Rough Fire, as noted in Chapter 7 there were no actual prescribed fire activity in the vicinity. Within the ES we note that the case study fires were selected to satisfy criteria for inclusion as a case study, specifically, the level of information available, the fire needing to occur on federal land, and that the case study fire was managed by both USFS and DOI.
1	p.ES-2, line 16: The CI on TC6 is huge ($2M to $47M). Such imprecision in the estimates raises red flags. What is driving the huge CI? Is this indicative of a problem with the methods and/or BenMAP-CE? Similar for the Rough Fire (which has an even larger CI). The Rough Fire CI is so large as to almost make the analysis irrelevant for policymaking purposes ($260M to $7.9 billion; huge range). It seems to me that much more work needs to be done to reduce the variance on these estimates.	BenMAP estimates health impacts and corresponding economic values based on information from peer-reviewed epidemiologic studies. The range in dollar values reflects the confidence intervals (i.e., standard errors) surrounding the risk estimates reported in epidemiologic studies, as well as the distribution of the VSL and does not mean there is an issue with BenMAP. Some of the breadth in the confidence intervals is due to large uncertainties in the societal value of reductions in the risk of premature death. Additionally, this analysis is not meant to inform policy.
1	p.ES-2, lines 25-27: "The hypothetical scenarios for both case studies demonstrate that prescribed fires targeted for specific locations can have an effect on reducing the overall size of a wildfire." My read on this is that you assumed a hypothetical Rx fire and then attempted to	Overall, the generalizability of results from the two case studies are limited to only the case study areas as noted within this report. A hypothetical prescribed fire was only used for the Rough Fire case study. As noted within the report, the Rough Fire was selected to satisfy the

Reviewer	Comment	Response
	simulate/model what the wildfire extent and associated smoke health impacts would have been with said fire. This is troubling to me that a hypothetical Rx fire was used and not an actual Rx fire that had been previously burned on lands where a wildfire occurred at a not-to-distant later date. Why use a hypothetical Rx fire? Why not use an actual Rx fire? The limitations of using a hypothetical Rx fire for this analysis should be clearly stated up-front. They limit the generalizability of the findings.	requirements that the fire had to have occurred on federal land and be managed by both USFS and DOI. Actual prescribed fire activity occurred within the vicinity of the TC6 fire.
1	p.ES-3, lines 10-12: "Therefore, analyses do not consider how prescribed fires intersect with wildfire activity, including the probability of a wildfire occurring within the spatial domain of prescribed fires." This is a critical limitation of the current analysis. By not using an actual Rx fire for your analysis, you are unable to empirically study the linkages between Rx fire and wildfire activity on the same land. This is problematic for me because in practice, we need an answer to how actual on-the-ground Rx fires affect future wildfire extent and severity (with associated future smoke health impacts). This report is unable to address this question, which severely limits its practical usefulness, in my opinion.	We agree we need an answer to this question, but it was outside the scope of the assessment we were asked to conduct. As a result, we note in Chapter 9 that future research is needed to try and address this question.
2	First, the report is better understood as two reports smooshed together: a summary of the state of the science of wildfire management and impacts, and a case study of specific health impacts from two specific fires. The case studies are the main contribution of the report, but much of the rest of the report has very little to do with it. There is an entire section on wildfire air pollution monitoring that is barely relevant to the case studies. The same is true for the ecological impact section. It would be better if the	We have revised the conceptual diagram to convey the importance of the air quality monitoring chapter. In addition, we revised the introductions of each chapter to better link each back to the conceptual framework and better tie the report together. We also reordered chapters to delineate between those that provide qualitative information and context and those that focus on the quantitative analyses.

Reviewer	Comment	Response
	two elements of the report were separated into two separate reports, or perhaps a main report and an annex. Mixing them together reads as incoherent.	
2	Second, the case studies themselves are very interesting and constitute an important contribution, but their presentation is extremely confusing. Specifically, each case study of a fire includes several counterfactual versions of that fire (though a different number of counterfactuals for the bigger fire than the smaller one). Furthermore, each of the counterfactuals incorporates information from a unique combination of actual historical prescribed burns, hypothetical prescribed burns that were planned but never took place, and historical wildfire burns that had an effect similar to prescribed burns. The main wildfires under study are named, and some of these other fires or prescribed burn campaigns seem to have names, too. All of this is quite confusing to the reader. Even after reading the descriptions of all the different counterfactuals in many different places in the document I was unable to remember which counterfactual was modeled which way. The case studies desperately need some sort of overarching graphic or table that lays out all the scenarios. The maps are helpful but not enough. Using the names of the secondary fires or burn campaigns adds nothing but confusion.	The descriptions presented by Reviewer 2 represent a combination of the two case study fires. Because each case study was unique a different set of assumptions went into developing hypothetical scenarios. We carefully reviewed the text, descriptions, results, and notations throughout the report to ensure consistency in how each case study and the corresponding hypothetical scenarios are described.
2	Third, the case studies are begging to be further interpreted. Would a prescribed burn campaign leading to a smaller fire have actually reduced the overall health impact compared to the observed fire? Somehow the report never answers this very central question, this question that the structure of the case studies appears specifically designed to answer, or, if it did, the answer	As noted throughout the report, the results of each case study are specific to each of the case study areas. As a result, interpretation of results is limited to the case study area and cannot be extrapolated to other geographic locations. Therefore, broad statements like those desired by the reviewer are not appropriate. The “Key Insights” detailed in Chapter 9 are meant to reflect the overarching

Reviewer	Comment	Response
	was so de-emphasized that it eluded me when I was specifically looking for it.	observations of the analyses conducted and were revised for clarity based on this comment.
2	Fourth, the state-of-the-science part of the report should include a discussion of how fire impacts intersect with equity. Do certain socioeconomic groups experience higher ambient concentrations, higher exposures, or stronger concentration-response relationships? Are some groups more able than others to access public health messages and act on them? Are some able to afford health risk mitigation actions that others can't afford? There is at least a little literature on this already that should be discussed and hopefully included in the mitigation modeling.	While we agree that equity issues are important in the context of wildfire smoke exposures, this is outside the scope of the assessment we were asked to conduct by the Wildland Fire Leadership Council (WFLC).
3	Enjoyed the report. It gives a good starting point for risk management decisions based on wildland fire generated smoke.	Thank you.
4	This report develops a conceptual framework for understanding, and potentially quantifying, the tradeoffs between prescribed burning and wildfire. The key strengths of the report include a strong background discussion and literature review of the many facets of the problem and a well thought out conceptual framework. Some chapters are excellent, and the final synthesis chapter presents the key findings and limitations well.	Thank you.
4	A weakness of the report is its very narrow quantitative focus. Though the conceptual framework is holistic, and the various aspects are discussed, only a small portion of the framework is quantified with a specific modeling case study. The findings of the case study are quite limited because they may not be broadly applicable to other locations or even times. To bolster the case studies, I would suggest a statistical approach, where a large	We agree with the reviewer that the quantitative analysis is narrow in focus. This is because we were only tasked with examining the smoke impacts. However, we felt it was important to put the impacts we were quantifying in the context of the broader impacts of wildfire. Unfortunately, an analysis suggested by the reviewer, while interesting, is outside the scope of this assessment.

Reviewer	Comment	Response
	number of hypothetical fires are modeled across many different locations and weather conditions to better explore the range of impacts.	
4	Another important weakness of the report is its structure. The chapter progression does not make sense to me. Text switches back and forth between the broader qualitative discussion and details of the case study analysis. I would prefer the document broken into two major parts: one with the conceptual framework and background information that applies to that framework in all cases, and one on the case study, including info on the specific forests, land management, air quality modeling details, results, etc. Finally, the report could use a high-level editor. There is much repetition and significant style differences between the chapters.	The chapter order was revised to better delineate between the chapters that provided context and those chapters focused on the quantitative analysis of the case study areas. Introductory sections were also developed for each chapter to show the importance of each and how each tie back to the conceptual framework. Additionally, the report underwent a technical edit prior to completion.
5	The organization made the report difficult to follow. Some of the questions and confusion I had reading through the document weren't addressed until the final chapter. The chapters addressing the actual case study analyses are broken up and should be consecutive. There are also varying levels of detail given to factors part of the conceptual framework, but not addressed in the case study analysis, with some chapters providing in depth syntheses and others providing a brief overview. The scope of the discussion should be more consistent throughout. Overall, I found the conceptual framework hard to follow. There needs to be a better description of its intent and flow, and how it relates to the case study, early in the report.	The chapter order was revised to better delineate between the chapters that provided context and those chapters focused on the quantitative analysis of the case study areas. Introductory sections were also developed for each chapter to show the importance of each and how each tie back to the conceptual framework. Additionally, Chapter 2 was revised to convey its intent.
6	This is an outstanding case study. It's interesting, and it is a useful contribution to science. I applaud the EPA scientists (as well as those from other collaborating governmental agencies) for this work.	Thank you.

Reviewer	Comment	Response
6	Perhaps not a "critical deficiency," but something that I think should be addressed: I was surprised to see the list of concentration-response functions used in the "primary" analysis were from studies of urban air pollution. It's fine, but it feels out-of-whack with Chapter 6, which didn't really comments on these studies (at all), but instead focused on the studies of wildfire smoke. Also, when I read 8.2.3, I didn't understand why there were CR functions for long-term PM exposure being used in this analysis – I think better justification for this is warranted – scientifically, I don't understand the rational for applying CR functions for long-term PM exposure to a ~60 day fire event. Also, some of the CR functions (e.g., Katsouyanni et al. 2009) aren't from the US, which seems at odds with the focus on US studies in Chapter 6, since there are a lot of international studies of health effects of fires (e.g., from Australia) that could be relevant.	Text was revised in the health effects chapter to clarify why the main BenMAP analysis focused on C-R functions based on epidemiologic studies of ambient $PM_{2.5}$. The function for long-term $PM_{2.5}$ exposure was only used for the Rough Fire analysis. This function was selected because the Rough Fire represented a multi-month fire that is considered representative of a longer-term exposure and a multi-month event can have measurable changes in annual exposures to $PM_{2.5}$. This differs from the Timber Crater 6 fire, which only lasted a few days. While the Katsouyanni et al. (2009) study does present a combined result that includes countries outside the U.S., the U.S. only estimate is used from the study in the analyses conducted within this report.
6	Beyond the previous comment, I did not find any "critical deficiencies" in the report. However, I've provided several comments for the authors to consider.	Thank you.
6	Section 1.2 gets to the main contribution of the report – "the overall air quality impacts of different fire management strategies, which consist of different land management practices, including prescribed fire, are not well characterized)." This is reiterated in Section 1.3, which elaborates on the "modelling component of the analysis, which is the main focus of this report" and takes us through the hypothetical scenarios. However, the Executive Summary seems to have more of an economic value focus rather than an air quality focus, which feels a bit misaligned with the rest of the report – having read the	The report covers both what the impacts are of these different land management strategies, the impacts and why it is important to understand these different strategies, and the modeling work to do the comparison between these strategies.

Reviewer	Comment	Response
	executive summary first I wasn't expecting such a heavy focus on the air quality modeling.	
6	The Executive Summary doesn't convey the uncertainty that is commented on extensively in Chapter 2 – perhaps one sentence to this affect could be added.	Text was added to the Executive Summary to convey the uncertainty noted by the reviewer.
6	There are some small grammar issues in the report – I assume these will get fixed once the scientists finalize the content and it gets routed for editing.	The report underwent a technical edit prior to finalization.
6	Consider having Chapter 8 follow after Chapter 6. It seems like the logical next step (to me) in terms of organization. Or maybe consider having Chapter 7 come before Chapter 6.	Chapters were reorganized to delineate between chapters that are providing context and those chapters that are providing quantitative analysis.
7	This report is best when it plays to the strength of the US EPA and covers topics such as air quality monitoring and chemistry, human health effects, and water quality. When covering these subjects, this report is excellent. Where the report ventures into forest ecology, land management, and ecological effects, the text is good overall, but needs revision to correct instances where framing is incomplete or important details are lacking.	Revisions were made to clarify sections mentioned in this comment when responding to comments specific to each of the topics within the respective chapters.
7	Organizing a report of this scope is difficult. I found the organization challenging sometimes because information about the modeling exercise was scattered across a number of chapters. EPA might consider if there is a way to reorganize the report to have the information about the wildfire modeling centralized to within a single chapter. I see that different aspects of the modeling are imbedded within chapters that provide context, but that makes it challenging to understand the full scope of the model.	The chapter order was revised to better delineate between the chapters that provided context and those chapters focused on the quantitative analysis of the case study areas. Introductory sections were also developed for each chapter to show the importance of each and how each tie back to the conceptual framework. Additionally, Chapter 2 was revised to convey its intent.
7	The overall approach of focusing on two different western fires and then devising alternate scenarios for these fires to understand the potential influence of fuels management	We viewed this initial analysis as a first step in future analyses trying to address this complex question. We agree that approaches such as those expressed by the

Reviewer	Comment	Response
	practices on public health is interesting, but of limited veracity and breadth. Rather than attempt to understand more holistically the potential costs and benefits of different fuel management strategies by integrating probabilistic estimates of fire activity and behavior, the alternate scenarios were simply created by opaque "expert judgement". The limitations of this approach are identified in Chapter 9 and elsewhere in the text, but these limitations are significant. While the approach here is insightful, I was disappointed it was not more robust given the large number of scientists involved and the overall breadth of this report.	reviewer could add additional insight but based on the deadline in which this assessment needed to be completed, was outside the scope of this assessment.
7	One small but important issue that I see with this report is that it repeatedly frames contemporary issues with wildland fire in the U.S. as a problem of wildfires increasingly "encroaching" on human populations. In fact, and as acknowledged in the report, humans are increasingly living within wildlands that have regularly experienced fires for millennia and these humans are also a tremendous source of ignitions. The problem is not necessarily that wildfires are burning, it is that humans are now in the way of the fires. More specifically, our collective problem is that our priorities for the services that should be provided by wildlands have changed faster than our ability to manage those lands in a way that will provide these services in our contemporary ecological context. That puzzle of managing our (fire-prone) lands to provide our collective desired environmental outcomes is the foundational question of this report.	We revised text appropriately to ensure we are properly conveying the issue at hand as noted by the reviewer.
7	The executive summary was very clearly written and did a good job of synthesizing the information about the effects of the two studied wildfires and hypothetical	The Executive Summary was revised to ensure this information was highlighted.

Reviewer	Comment	Response
	alternatives. However, some of the most important findings of this report are the identification of knowledge gaps around monitoring, fully understanding health impacts, and quantifying environmental effects, but these topics were not covered by the executive summary. I urge you to include those items so that policymakers and others who may not read all the way through this lengthy report will also receive these key conclusions.	
7	Please, more commas! I've commented on a few instances where the lack of a comma forced me to reread sentences, but there are numerous other spots that would have benefitted from the addition of a comma.	The report underwent a technical edit prior to finalization.
8	Overall, the report does an excellent job introducing the reader to the issues involved in prescribed fires, fire management, and public health concerns. Air quality managers, especially in the western US, need to weigh the benefits and costs of prescribed fires, and to convince the public of the value of such fires as a tool to limit the potentially catastrophic impacts of large wildfires. These issues have acute importance, especially as climate change and accumulated fuel load make such large fires more likely.	Thank you.
8	The executive summary is well-written and convincing. This review outlines strengths and weaknesses by chapter.	Thank you.

Table 2. Reviewer comments on Chapter 1 (Chapter Specific Charge Question #1)

Reviewer	Comment	Response
1	p.1-2: Some mention should be made here that Rx fires can (and do) sometimes get out of control and become wildfires (e.g., the Cerro Grande fire in NM). There are small probability extreme risks associated with Rx fire too.	The text was edited to note that there is a chance that prescribed fire can unintentionally get out of control.
1	p.1-2: "To date, limited information exists that allows for a direct, systematic, and comprehensive comparison of the air quality and associated health impacts of smoke from prescribed fire and wildfire." I fully agree with this statement. However, to properly address this, a comparison of wildfire smoke health impacts with Rx fire smoke health effects from Rx fires on lands where the wildfire occurs in the future is needed. There is a tradeoff here that must be studied, empirically (not hypothetically). Will tolerating a little smoke today (from Rx fires) be worth it (from a health cost-benefit perspective) compared to a lot of smoke in the future from a wildfire? This needs to be worked out.	We agree we need an answer to this question, but it was outside the scope of the assessment we were asked to conduct. As a result, we note in Chapter 9 that future research is needed to try and address this question.
1	p.1-3: "While all these activities have led to significant advancements in the science, the overall air quality impacts of different fire management strategies, which consist of different land management practices, including prescribed fire, are not well characterized." This seems rather harsh. There are now many papers looking specifically at prescribed fire air quality and health impacts. See the 2019 special issue of the International Journal of Environmental Research and Public Health on "Air Quality and Health Predictions" where several Rx fire specific papers were included.	The studies of prescribed fire to date are not epidemiologic analyses examining the health effects of prescribed fire smoke, but instead quantitative analyses using tools such as BenMAP to estimate the potential public health impacts. These types of analyses assume that the health effects will be the same, but to date epidemiologic studies have not been conducted to confirm this assumption.

Reviewer	Comment	Response
1	As mentioned in my comments about the ES, I'm very concerned by the focus on hypothetical prescribed fires rather than using wildfires that occurred on previously Rx fire lands. This is especially relevant for the discussions on p. 1-4. The TC6 hypothetical scenarios pre-suppose that Rx fires can (and do) lead to the outcomes listed (e.g., a wildfire with less fuel, a smaller fire perimeter, and less daily emissions). These seem like reasonable assumptions, but they are at the end of the day only assumptions based on a limited amount of data and nascent science on our understanding the complex relationships between Rx fires and future wildfire activity. My first suggestion would be to go back to the drawing board and use actual Rx fires instead of hypothetical fires. If this cannot be done, then my next suggestion for improvement would be to better caveat the approach and to be more upfront with its limitations. Using the "hypothetical" language is a good start, but more substance should be provided in the methods section that at the end of the day, this report is modeling a fake Rx fire and is making assumptions on that fire's impacts to future wildfire activity (which are based on the best available science, but that science is currently hindered by data availability and limited understanding of the complex connections between Rx fire and future wildfire activity).	Overall, the generalizability of results from the two case studies are limited to only the case study areas as noted within this report. A hypothetical prescribed fire was only used for the Rough Fire case study. As noted within the report, the Rough Fire was selected to satisfy the requirements that the fire had to have occurred on federal land and be managed by both USFS and DOI. Actual prescribed fire activity occurred within the vicinity of the TC6 fire.
1	Figure 1-1 is nice and clear.	Thank you.
1	p. 1-7, line 1: Define "resource benefits"	We added a definition. Thank you.
1	p.1-8: "individuals taking precautionary measures to reduce smoke exposure can vary between wildfire and prescribed fire events depending on the presence and effectiveness of public health messaging as well as the amount of lead time available for messaging to inform the	This statement is based off the assumption that preparative actions are taken prior to a prescribed fire whereas such actions/messaging are not necessarily possible for wildfire events, which are spontaneous. The ability to take actions could be different between these

Reviewer	Comment	Response
	public and the public's ability to act on that messaging." Please provide citations for this statement. Seems speculative to me. We are only just beginning to understand the role that smoke alerts have on avoidance and mitigation behaviors. In fact, the latest EPA STAR grant on effective smoke communication strategies was an attempt to better understand this very point.	two types of fire events, which is all we are noting. We revised to the text to say "may vary" to soften it.
1	p.1-8, lines 11-13: "The examination of smoke exposure reduction actions within this assessment does not reflect a formal analysis of post-fire effectiveness of public health messaging for either the TC6 or Rough Fires." I agree. Yet, a "crude estimation" is still done. Is this dangerous? Shouldn't we wait until a more "formal analysis" can be done? As stated on p.1-8, "This report represents an initial step in the process of conducting assessments to characterize the impacts of different fire management strategies to inform both public health actions to reduce population exposures to wildfire smoke, and future land management decisions." It has the potential to be extremely influential in this regard. And, as the first major EPA report on the wildfire/Rx fire tradeoff (with respect to smoke and health), it is better to be cautious than complete, especially since this is an area of study that suffers from data limitations and many knowledge gaps. I'd rather EPA not put out a report on the basis of a "crude estimation", if the assumptions and models used in the "crude estimation" turn out to be inaccurate in the future. I guess that more caution is in order. Maybe the "crude estimation" is dropped from the report. It could potentially do more harm than good is my point.	The sentiment to be cautious is understood. The framing of the report is as a first of many steps to investigate and compare these scenarios. Instead of referring to the exposure reduction estimation as "crude" we revised the language to say, "illustrative example". We agree all information is lacking in order to provide a more concrete estimate, but it would be an oversight to not recognize that exposure reduction actions are possible and could have measurable public health benefits.

Reviewer	Comment	Response
2	The terminology and scenario numbering used in Figs 1-1 and 1-2 is inconsistent (two Hypotheticals vs. three Scenarios).	We checked other chapters to ensure consistency in how the scenarios are described and referred to. We also made revisions in Chapter 1 to clearly define each scenario and link to each figure.
2	Page 1-6 lines 8-9 are unclear.	Revised the sentence to two sentences: "In comparing air quality impacts between the actual Rough Fire and the hypothetical scenarios, air quality impacts are modeled for the entire 2 months of the actual Rough Fire. The model diverges at the point where the Rough Fire would have reached the perimeters of two fires considered within this case study, the Boulder Creek Prescribed Fire and the Sheep Complex Fire."
3	Page 1.1 Section Background Line 17/18- 'NIST is an expert in the direct and indirect 17 damages attributed to fire'. What do you mean by this?	Added "quantifying": "NIST is an expert in quantifying the direct and indirect damages attributed to fire…"
3	Page 1.1-Section 1.1, Line 23/24- 'Fire has been used as a land management tool to return nutrients to the soil and remove detritus 23 and excess fuels to reduce wildfire risk and effects.'- Think you need to use a different word for "Fire" at the start of the sentence, or add in the term prescribed fire, or add the word extreme (or something similar) to wildfire risk latter in the sentence. Fire along seems too vague.	Revised to say "Fire, both prescribed and cultural," which then is a good segue in the sentence that follows.
3	Page 1-2 Section 1-2, Lines 15/17. Is this the right wording? with the rapid expansion of the WUI, wildfires are increasingly encroaching on American communities, posing threats to lives, critical infrastructure, and property (Lewis et al., 2018). It seems like American communities are encroaching on wildland fires. The way it is currently worded, it makes wildland fire the "bad person", is it really?	Revised the sentence so it is similar to Chapter 9 to note that human development has extended further into fire-prone wildlands.

Reviewer	Comment	Response
3	Page 1-4 Section 1-3 Line 1- What are "positive resource benefits"	We clarified this sentence.
3	Page 1-8 Section 1-3 Lines 19/20- What about local economic conditions? Large fires close down business. That can be a large driver politically.	This is an important point but outside the scope of the document.
4	Page 30, sentence beginning on line 8 is not a sentence	We revised the sentence for clarity.
4	The descriptions of the scenarios in section 1.4 are confusing.	We revised the descriptions of each scenario and tied each back to the respective case study figure to improve clarity.
5	The authors correctly indicate that use of wildfire for resource benefit is also a critical fire management strategy on page 1-2 (lines 31-35). This concept should be carried through in the rest of the chapter. I recognize that the terminology can be confusing, as the term 'wildfire' can have a negative or positive connotation in this framework, but I strongly encourage the authors to adopt a terminology throughout the document that acknowledges that wildfire, more than being at times beneficial, is actually a is a critical fire management strategy.	Where appropriate, and specifically in the context of the Rough Fire case study, when referring to the Sheep Complex Fire we note that this fire yielded positive resource benefits.
5	Page 1-3 line 1: 'To ensure the effective use of prescribed fires and wildfire to reduce the risk of catastrophic fire' (or use agreed upon terminology to describe the beneficial use of wildfire.	Where appropriate, and specifically in the context of the Rough Fire case study, when referring to the Sheep Complex Fire we note that this fire yielded positive resource benefits. Overall, the focus of this report is on the tradeoff between prescribed fire and wildfire.
5	Page 1-3 line 13 'including prescribed fire and wildfire'	Revised.
5	Since this is the primary portion of the report where the scenarios are discussed, it would be useful to have more detail. How much prescribed fire is in each scenario, what are the sizes of wildfire in each scenario, etc. A table highlighting the details of the different scenarios would be useful and provide a quick reference the reader could refer back to throughout the report. There also needs to be	This section has been revised for clarity. The other details desired by this reviewer are presented in other chapters, specifically the air quality modeling chapter. Additionally, revisions have been made to other chapters to better link each back to the conceptual framework.

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	more discussion of linking these scenarios to pieces in the conceptual and expected value framework.	
5	Other comments on chapter 1 Page 1-1 line 17: 'incident management'	Revised
5	Page 1-1 line 20: delete the	Revised
5	Page 1-1 lines 21-22: 'linkages needed to address identified research gaps'	Revised
5	Page 1-2 lines 8-12: Important to note that spread of invasive species has also changed fire regimes, by increasing fuel continuity, not necessarily fuel loading.	Added "the spread of invasive species which increases fuel continuity" as requested.
5	Page 1-1 line 24: The goal of fuel treatments is not always to reduce wildfire size, more often it is to reduce fire intensity and severity	Revised to include intensity and severity in the overall reduction of wildfire risk.
5	Page 1-3 lines 9-10: and wildland firefighter health impacts?	Revised to include.
5	Page 1-4 line 2: consider using 'periodic' instead of 'episodic'	Revised
5	Page 1-4 line 15: was compared	Revised
5	Page 1-4 lines 20-27: what do these different scenarios mean for fire intensity? Instead of indicating less or more fuel, wouldn't less or more fuel consumption be a better descriptor?	Good point, revised.
5	Figures 1-1, 1-2, and 1-3: It would be better if these figures were consistent across the two fire case studies. Figure 1-1 is repetitive and doesn't add much value. Would it be possible to show prescribed fire areas in figure 1-2? In addition, figure 1-1 includes a baseline scenario, which is not described in the text.	Figure 1-1 has been removed. The figures for each case study area are meant to reflect the different hypothetical scenarios and text has been revised for clarity. Within the air quality modeling chapter there is a figure that depicts the prescribed fire activity for the TC6 Fire.
5	Pages 1-4 and 1-5: Descriptions of the different fires and their scenarios read as if they were written by different authors. It would be helpful to the reader if there was	The text has been revised for clarity and consistency.

Reviewer	Comment	Response
	more consistency in language and structure of the descriptions of the different modeling scenarios.	
5	Page 1-8: Lines 21-28: Consider introducing the goals of the report prior to the 'novel approach' section, especially the first paragraph of this section. The second paragraph (lines 29-34) is more appropriate for the end of this chapter.	The text under the background section was revised to better convey the goal is to assess the smoke impacts.
6	I think Chapter 1 is effective in introducing the assessment. I like the figures showing the hypothetical smaller/larger scenarios relative to the "baseline" scenario (perhaps a better description than "baseline" is "actual fire scenario" or something like that, although "baseline" was also clear to me).	Based on comments from other reviewers this figure was removed.
6	Section 1.3 is titled "Novel Approach." It might be worth being explicit as to what exactly is novel (this is not a criticism that the work isn't novel; I am asking for clarity in the authors articulating what specifically about the work is novel).	Good point. While many of the components of the assessment are novel, a better heading is "Analysis Approach".
6	Clearly, there are details that aren't developed in Chapter 1. For example, there is virtually no discussion of how the public health impacts / effectiveness of public health messaging are modeled, where those estimates come from, and so on. But I think this is fine for Chapter 1 – saving these kinds of details for later chapters makes sense to me.	We agree, and as noted by this reviewer the point of Chapter 1 is to set up the rest of the document. Other chapters contain the information desired by this reviewer.
7	I think Chapter 1 is successful in providing the rationale, approach, and goals for the report. I have some comments about how this work and contemporary issues are framed, which are detailed below. I don't see need for fundamental changes to this chapter, only changes in language.	Thank you

Reviewer	Comment	Response
7	P1-1 L24: Not just wildlife habitat, but also habitat for plants and other organisms.	Revised.
7	P1-2 L2-7: Fire suppression isn't an ignition source and climate change isn't an ignition source, except for possible changes in lightning frequency. However, all of these things influence the occurrence of wildfire. Also, this sentence implies that the occurrence of wildfires has increased, but that contradicts line 10 in the next paragraph. I realize the two statements have different time frames, but it is still a contradiction.	We revised the sentence for wildfire ignitions to catastrophic wildfires to address both comments.
7	P1-2 L13: Animal and plant habitats	Revised
7	P1-2 L15-17: I disagree with the framing that fires are encroaching on communities. Communities are encroaching on natural systems that have burned for millennia. I would suggest deleting "encroaching on American communities" and simply say that wildfires are increasingly posing threats to lives, etc.	Revised to address this issue.
7	P1-2 L21-22: This is a good and important sentence, but I think there is an equal need to recognize that the accumulation of wildfire fuels is also inevitable and that without extensive intervention, wildfires themselves are inevitable. This is a crucial point that needs to be made prominently in this report.	Revised the sentence to address this point.
7	P1-6 L1: Every fire will increase some ecosystem process/function/service that has a value to someone, so it is a bit imprecise to say a fire "resulted in resource benefits". It would be more appropriate to say the fire was "managed for resource benefits". Some organisms, like the black-backed woodpecker, like extensive stands of dead trees killed by wildfire. High-severity fires would also likely increase streamflow, a benefit to downstream water users.	Text was revised to clarify this statement.

Reviewer	Comment	Response
8	Chapter 1 does a good job laying out the rationale, approach, and goals of the report, and this reader was impressed by the intra-agency effort to address the issue of prescribed fires in the western United States.	Thank you.
8	Section 1.3. A table or bullet list of the different scenarios for each fire would be helpful. Such bullet lists appear in Chapters 8 and 9. Also, the text states that the scenarios "equate to" specific conditions, but "represent" would be the better word choice.	The text describing each scenario was revised and turned into bullets to improve clarity.
8	Page 1-7. Describing more exactly the "resource benefits" of the Sheep Complex Fire would be helpful.	We defined what is meant by resource benefits earlier in the chapter which address this comment.

Table 3. Reviewer comments on Chapter 2 (Chapter Specific Charge Question #2)

Reviewer	Comment	Response
1	p.2-2: "The overarching question that guides the evaluation conducted within this framework is What are the expected effects (both positive and negative) of alternative fire management strategies over both short (during the event) and long term (post-event) time horizons? with an emphasis within this assessment on the smoke impacts." This is exactly the right question that should be asked and I applaud the report to taking this issue on. It is relevant to on-going discussions both at the Federal and state level as well as in the academic community. What are the benefits and costs of Rx fires in the short-term and in the long-term and how do these compare to what would have happened in the absence of Rx fire (i.e., in terms of future wildfire smoke and health impacts)?	Thank you
1	The discussion in section 2.2 "Expected Value Framework" is good. One thing that should be added and discussed is the literature on the expected returns on fire management strategies on future avoided suppression costs (see Sanchez et al., 2019). The focus on this report on smoke and health is fine, but one must acknowledge other avenues that the broad charge to investigate fire management strategies can take (such as on future property damages and suppression).	Citation added where suggested.
1	p.2-3, line 20: Recommend adding the Sanchez et al. (2019) cite to this sentence.	Citation added where suggested.

Reviewer	Comment	Response
1	The implicit functions in Equation 2-1 need to be written in the equation. The text on line 24 says that PF is a function of M, but that is not shown in Eq. 2-1, for example. It should be. Similarly for NF, conditional on M.	Changes made to the equation.
1	Another concern that I have with Eq. 2-1 is that there is an inherent temporal component that is missing here. Rx fire effects are immediate, but wildfire impacts are delayed, perhaps by years or even decades into the future (depending on the ignition probability). Economists use discounting to relate dollar benefits/costs over time. Yet, no discounting is presented in Eq. 2-1 (and it should be). Suggest a more formal equation be written that incorporates best practices from the Expected Net Present Value (ENPV) economics literature. You cannot simply compare costs and benefits together when they occur at different points in time. This is incorrect. Specifically, the EV-C equation on line 3 of p.2-4 is not valid, unless the individual EV and C terms are in present value terms (and no mention is made in the text that they are).	We added the temporal component to the equations. However, we do not have adequate information on either the temporal pattern of prescribed and wildfires, or the year-by-year wildfire probabilities. As a result, the case studies primary results assume that all of the fire scenarios occur in the same year, while acknowledging that in fact they will likely occur in different years. We are not able to account for either the delay or the uncertainty in this initial case study approach. These aspects will need to be addressed in future analyses.
1	Figure 2-1: Define “non-fire adverse impacts”. Ash, GHG emissions, and smoke emissions are all fire impacts. They don’t occur without fire, so I don’t understand what is meant by “non-fire” in this context. Second, I would argue that the green box “Improved forest health” should be linked to the “Probability of wildfire ignition” box. Rx fires affect future fire ignition precisely because they do improve the overall health of the forest. These two things are connected and cannot be separated as they are in the figure. A similar argument could also be made to connect “Ecological benefits” and “probability of wildfire ignition”. Third, it is not clear what is meant by “ability to	We have now provided a somewhat simplified conceptual graphic to focus more on the elements that are included in the quantitative case studies. We also now refer to smoke, ash, and GHG impacts as “combustion-related impacts”. While we agree that prescribed fires affect ignition probabilities through improved forest health, we feel that the arrow from prescribed fires to wildfires conveys that prescribed fires impact the conditional probability of wildfires as well as impacting the severity and extent of the wildfires. Additional arrows would make the diagram unwieldy. We have also added an

Reviewer	Comment	Response
	mitigate impacts" or "ability to mitigate exposure". How does wildfire mitigate impacts to, for example, firefighter health and safety? If anything, wildfire is harmful to firefighter health. I'm missing the link. When I think of mitigation, I think of public health advisories or smoke alerts that provide people with information so that they can take actions to limit/reduce their exposure to smoke/fire. Similar for the link between Prescribed fire and "Ability to mitigate exposure"; what is meant by this? As in Rx fires can reduce future exposure to smoke from wildfires since those wildfires will be less severe due to past Rx fires? Please clarify. Finally, mortality and morbidity are not the only effects of fire and smoke. Labor market effects, education effects, productivity effects, and other economic outcomes have been shown to be affected by smoke exposure. Suggest broadening your assessment (or explicitly state that you are ignoring them).	"other effects" box to the air quality impacts to address the labor market, education, and other economic effects. With respect to mitigation of future wildfire impacts, this is a temporal component, which was not clearly articulated in the draft report. To improve clarity this box was removed from the figure.
1	p.2-8, line 12: P(control) was not defined in Eq. 2-1. Please clarify or define.	Fixed by replacing P(control) with $F_{it}\|M_i$ which is fire damages conditional on management practices.
1	p.2-9, lines 26-27: "About 89% of the fuel treatments were effective in changing fire behavior or helping with management of the wildfire or both" This needs to be significantly expanded and elaborated on. One of the central assumptions made in this report is that a hypothetical Rx fire will measurably affect future wildfire extent, emissions, etc. This assumptions needs to be carefully explained and defended.	This point was addressed in Hunter et al. (2020) and we now cite this at the end of this sentence.

Reviewer	Comment	Response
1	Table 2-1: The list of "Unquantified Effects" are not all actually unquantified in the relevant literatures, its only that this report has made the choice not the quantify them. This is an important distinction that should be made clear. For example, the economics literature provides estimates of property, timber, tourism, etc. costs of wildfire. This report is simply focusing on smoke and health. Please don't give the impression that some of these other impacts are unquantified in the literature (which is not accurate). Additionally, under the "Public Health: Air Quality" effects, there are many more that are not stated here (e.g., labor market effects, educational effects, etc.). Similar for air quality (i.e., other pollutants created by fire). This is an incomplete list. Suggest listing other Air Quality and Public Health impacts, but then state that this report only focuses on xyz. Otherwise, the impression is given that fire is only associated with those impacts listed (which is not true).	The Appendix contains a table that provides a more comprehensive list. Added additional table entries for unquantified other air quality impacts.
1	p.2-15, lines 12-15: "Because of uncertainty regarding when wildfires occur relative to when prescribed fires occur, it is challenging to determine the timeframes for comparing the two types of fires. For this assessment, we present undiscounted dollar values, which assumes that benefits and costs of fire management strategies all occur in the same current year." This is extremely problematic and cannot be done in the final report. Prescribed fire effects are immediate whereas wildfire impacts are years, if not decades, in the future. An undiscounted comparison of these two sets of monetized estimates should not be done, full stop. Some assumption needs to be made on the timeframes involved (with a sensitivity analysis performed on that assumption) so that a net present value	We do not have adequate information on either the temporal pattern of prescribed and wildfires, or the year-by-year wildfire probabilities. As a result, the case studies primary results assume that all of the fire scenarios occur in the same year, while acknowledging that in fact they will likely occur in different years. We are not able to account for either the delay or the uncertainty in this initial case study approach. These aspects will need to be addressed in future analyses. To demonstrate the potential impact on the dollar value of health damages, we have added a paragraph to Chapter 8 showing the impact of a delay of 5 or 10 years between the prescribed fire (assumed to occur in a current year) and a subsequent wildfire. These are not intended to be

Reviewer	Comment	Response
	analysis can be performed. Benefits and costs do not occur in the same year, as stated on line 15. This is a major shortcoming of the report that must be addressed. Wrong conclusions and policy implications can be reached from not incorporating discounting.	viewed as alternative estimates for the case study, but rather as an illustration of the impact of discounting.
2	I liked the conceptual framework for how it shed light on the choices made in the case studies. For example, page 2-2 lines 1-12 are much clearer than section 1-4. However, I don't think the framework requires that the report spend so many pages in later section on aspects of fires that aren't captured in the case studies anyway. I also think the framework needs to include some indication that impacts are filtered through existing socioeconomic inequities.	Added a sentence to section 2.3.5: The ability of communities and individuals to engage in behavioral actions to reduce exposures may depend on existing socioeconomic conditions and may be limited by inequities in community and individual capacities to respond to information on burning activities and smoke.
2	Equation 2-1: if all the terms in the equation are conditioned on M this should be reflected in the notation.	Done.
2	Fig 2-1: Do thinning or prescribed fire reduce the probability of wildfire to zero? Why isn't the Wildfire box connected to Mitigation Decision if Wildfire explicitly conditioned on it in equation 2-1? Also, the position of "Ability to mitigate impact" and "Ability to mitigate exposure" on top of arrows is unclear.	Revised
2	Page 2-8 line 12: If Pr (control) is being modeled perhaps it should appear in Fig 2-1?	Pr(control) has been removed. Fires are managed for resource benefits or suppression, so the probability of "controlling" a wildfire is not a correct framing.
2	Table 2-1: Emergency department visits are list as both "quantified" and "unquantified". Which is it?	ED visits associated with direct fire injuries are not quantified. ED visits associated with air pollution resulting from fires is quantified,

Reviewer	Comment	Response
2	Page 2-15: I appreciate the lack of discounting. People in the future will value breathing just as much as people in the past.	While we are presenting impacts of different fire scenarios as if they occur in the same year, in fact they will likely occur in different years. It is appropriate to discount the monetary value of future impacts relative to impacts occuring today. Discounting does not mean that people in the future have lower values for health effects compared to people today, it means that the value to people today of impacts that will occur in the future is lower than the value of impacts that occur today. If decisions are being made today to use or not use prescribed fires, they should take into account both the potential delay in when a future wildfire might occur, as well as the uncertainty in the occurrence of a future wildfire. We are not able to account for either the delay or the uncertainty in this initial case study approach. These aspects will need to be addressed in future analyses.
3	Page 2-3 Section 2-1 Line 9/10. You state "framework that gives 9 primary consideration to public and firefighter safety", can you have both or does one need to take priority over the other? Someone has to take the risk?	The intent of this statement was simply to place human life above the value of property and natural resources, as evidenced by the Management Intent stated in the 2009 guidance document: *Guidance for Implementation of Federal Wildland Fire Management Policy* (2009). Where it states that "No natural or cultural resource, home, or item of property is worth a human life. All strategies and tactics should seek to mitigate the risk to firefighters and the public.

Reviewer	Comment	Response
3	Page 2-6 Section 2-3 Line 27- You talk about "Effects are expected to vary based on characteristics " but do not reference fuel model, you kinda do as biomass burned, but might want to clarify with a reference to fuel model. A lodgepole stand fire is a stand replacement vs a ponderosa pine stand is typically undergrowth. The fuel model typically dictates the fire conditions.	Changed "biomass burned" to "fuels". Fuel models are not able to provide causal information on variability in effects.
3	Page 2-08 Lines 30/31- You state: It is only implemented when conditions meet preplanned elements". I would reword to state that it is only implemented when the resource benefit as outlined in the burn plan is meet.	Edit made to text as suggested.
3	Page2-13, Section 2.3.5 -Lines 4/5: You state "using 4 N95 facemasks when outdoors to mitigate exposures" is this recommended across the country? Many public health agencies do not recommend masks.	The use of N95 is a recommendation that is listed in EPA, CDC, and other state level guidance. We did not make any revisions to this sentence since the mention of N95 is used as an example of actions that could be taken to reduce exposures.
4	The overall conceptual framework is appropriate, understandable, and comprehensive. However, while the framework itself is comprehensive, the study is not, being narrowly focused on public health impacts from smoke. The authors acknowledge this, and the framework will hopefully be useful for future work. This study just scratches the surface.	We agree with this commenter. We lay out some of the key uncertainties and limitations that might be explored in future analyses in Chapter 9.
4	Page 41, line 3. Aren't there multiple possible goals for prescribed burning? Not just reducing wildfire?	Yes, these are described in the first paragraph of 2.3.3.1

Reviewer	Comment	Response
4	Section 2.3.5 paragraph 1. This paragraph asserts that more public actions can be taken to mitigate smoke impacts from prescribed fires than wildfires because of the potential to plan health messaging campaigns, but is that borne out? My experience is that the public takes more mitigation measures during wildfires. Also, why can't these communication and public awareness activities take place during wildfires?	Prescribed fires allow for an opportunity to have concerted public health messaging campaigns due to their planning nature. While messaging occurs during wildfires on actions that can be taken, the spontaneous nature of a wildfire can have implications on the ability of the public to take various actions. We do not disagree with this reviewer that similar messaging campaigns can occur for wildfires.
5	Several things make the graphical representation of the conceptual framework difficult to understand and follow. For one, the authors go straight to a detailed description of the expected value framework to a graphical representation of the conceptual framework, without a clear description of how these relate. There is also no description of what the graphical representation is meant to convey, other than a long section defining and describing terms, some of which are inconsistent with what is shown in the graphic. Is the graphic meant to convey the expected value framework in the context of smoke and air quality? If so, that is not clear and the terminology between the expected value framework and the conceptual diagram is inconsistent. In addition, there are many aspects of the conceptual diagram are confusing. For example, why is there not a relationship between baseline conditions and wildfire, as is described in the text? What does the 'ability to mitigate' box connected to wildfire refer to? Why are ash, GHG emissions, and smoke emissions considered non-fire impacts? Why doesn't prescribed fire have the ability to mitigate non-smoke fire impacts? I suggest greater thought and attention to detail put into a revised conceptual diagram, that is more clearly linked to the	We revised the conceptual diagram figure and created a simplified version of the conceptual diagram to focus more on the elements that are included in the quantitative case studies. We have added language to clarify the purpose of the figure and clarifying that it does not represent the temporal patterns of prescribed fires and wildfires.

Reviewer	Comment	Response
	expected value framework (if indeed that is the intent), is consistent in terminology, and perhaps a simpler design. A simpler design could be achieved by omitting examples from the diagram itself (e.g., GHG, ash) and leaving those in the descriptions of broader terms (e.g., direct and indirect impacts or effects).	
5	In general, I'm not convinced that there is value in adding a detailed description of the expected value framework, when it does not appear to have been used in this case study analysis. The discussion of this should either be minimized, or somewhere in this report there needs to be a discussion of how the case study analysis links to pieces of this expected value framework and what pieces are missing and would need to be included in order to complete the framework.	We disagree with this comment. It is important to convey the "ideal" framework first and then indicate what we are able to do with this report. That provides the appropriate context for viewing uncertainties and limitations with the case study approach. We have expanded the discussion of how the case study links to the conceptual framework.
5	Page 2-2 lines 18-19: Instead of 'reduction or increase in fuel loads', consider change in fuel characteristics, since some changes in fire behavior and effects are due to changes in fuel continuity, or other characteristic, and not always due to increases or decreases in fuel loading.	Change made to text
5	Page 2-2 lines 18-22: The example of maintenance burns in the Southeast as an example of the previous statement is confusing, as the previous statement refers to wildfires, not prescribed fire. This in addition to the sentence starting with "the range of periodicity…", while correct, seems misplaced and disrupts the flow the paragraph. I suggest deleting these sentences and start again with "the management of wildland fire"	Added clarification to the previous sentences to clarify application to prescribed fire.
5	Page 2-2 line 23-24: Delete "Fire management strategies such as". You've already separated wildfire in the previous sentence, and established that it has positive and negative effects.	We revised this sentence for clarity.

Reviewer	Comment	Response
5	Page 2-2 line 24: change “fire” to “wildfire”	Fixed
5	Page 2-3 lines 3-4: pick impacts or effects, don’t include both	Fixed
5	Page 2-3 line 13: By management do you mean the opportunity to manage wildfire? This is unclear.	Revised
5	Page 2-3 equation 2-1: Should F be WF? The equation already has prescribed fire related effects, shouldn’t the last part refer to wildfire related effects?	Fixed
5	Page 2-3 line 25 and 26: specify that F is referring to wildfire -related effects once a wildfire is ignited	Fixed
5	Page 2-3 line 27: positive and negative effects associated with fire management strategy and wildfire?	Added a footnote clarifying that probability weighted wildfire effects are part of the overall effects of a management strategy
5	Page 2-8 line 12: this is the first mention of P(control), it is not listed in the EV equation or the conceptual framework diagram	Removed
5	Page 2-9 lines 12-16: There is lots of data on the degree to which mechanical thinning, alone or in conjunction with prescribed fire changes the probability of ignition or intensity and severity of wildfires and many studies published since Agee and Skinner 2005.	Added other references.
5	Section2.3.3.3 – I suggest deleting this section and adding a statement to the section above about the effectiveness of mechanical treatments. You could certainly still cite IFTDSS 2021, but I see no need to highlight this particular program in this report.	We disagree. The IFTDSS report provides an outcome metric that applies the science and demonstrates that agencies take monitoring of the investments in treatments seriously.
5	Section 2.3.4 – should this be titled the effects of wildland fire?	No, this section includes effects of both prescribed and wildfires. We changed the title to Effects of Wildland Fires
5	Page 2-10 line 33: Cheatgrass is not a good example of an invasive species that fire helps control. Yellow star thistle might be a better example.	We removed the sentence to reduce confusion.

Reviewer	Comment	Response
5	Section 2.3.4.1.2 – Why not call this ability to mitigate impacts, to be consistent with the conceptual diagram	Added this clarification to the title
5	Page 2-11 line 28: Here and throughout, I would argue that fire effects do not depend on the type of fire (prescribed vs. wildfire), but on the burn conditions, because both types of fire can have a wide range of burn conditions.	Prescribed fires control the burn conditions and thus create a difference with wildfires in the types of expected effects.
5	Page 2-14 Table 2-1: Loss of ecosystem services is listed as an example of effects on property. Is this correct? I'm not sure what this would entail outside of other listed economic effects – timber and grazing, municipal watersheds, aesthetics, tourism, natural and cultural resources. Should biodiversity be included under ecological?	Additional edits have been made to clarify that the list is not exhaustive.
6	Chapter 2 covers a lot of the background that goes along with the conceptual framework. I am realizing that several of my comments are on the figures and tables, and I think the authors have done a good job with these. Sometimes reading a big report it's hard to keep track of everything, and the figures and tables help a lot. Even something like Table 2-1 – which might seem unnecessary given what is in the text – I found it was very efficient at helping me understand what is going on.	Thank you.
6	Equation 2-1 seems inconsistent with the written description as to whether certain terms are conditional on Mi – somethings are written in the equation as not being conditional whereas the description says they are conditional.	Fixed.

Reviewer	Comment	Response
6	Figure 2-1 is helpful, although some things are a little unclear (e.g., the difference between ecological impacts and ecosystem impacts). Also the two categories of "non-smoke impacts" and "non-fire impacts" is a little confusing…would it be more straightforward to call them "smoke impacts," "fire impacts," and "other" (if a third category is needed)?	We revised the figure to improve clarity.
7	Although there are issues with some of the text framing wildfires, the chapter is successful in providing context for subsequent chapters. Figure 2-1 matches the structure of the chapter, but it also does not fully describe interactions between prescribed fire, "resource benefits", non-smoke fire impacts, and risk of wildfire. As currently constructed, figure 2-1 is bit confusing. For instance, the "Management Decision" box has a number of arrows coming out of it. All of the green arrows and the orange arrow appear to be coming out of only "Prescribed fire", while "probability of wildfire ignition" seems to be flowing from the "Management Decision" box as a whole. In reality, there would be some benefits also from mechanical thinning or even from "no action" (lower implementation costs). I would suggest either making this diagram more complete to show those benefits/costs or removing "mechanical thinning" from the list. I would also remove "ash" and "GHG emissions", or at least make them a different color than the smoke boxes. Ash and GHG emissions are both certainly components of smoke plumes, but GHG emissions have no direct human health effects, while ash has a number of negative (contributes to smoke, decreases water quality, etc) and positive (soil nutrient cycling) effects. Ash and GHGs are also components of smoke emissions, which makes unclear	We revised the figure to improve clarity.

Reviewer	Comment	Response
	why they are distinct from the smoke emissions box. (Though arguably, ecosystems will remain a net GHG source to the atmosphere for some time following a severe wildfire.)	
7	P2-3 L11: Intensity is energy output, but over a defined space and time. It is possible for fires to release a lot of energy over a long period of time in a low intensity fire. For the text, I would suggest providing example units of W m-2 to better convey the nature of fire intensity.	For the context of this report, we believe what we have is sufficient. However, we recognize there are many other possibilities of describing intensity that could be identified.
7	P2-4 Footnote: Some of these effects, such as air pollutant emissions from heavy equipment, chainsaws, and trucks could be quite easy to quantify; others have quantified these emissions.	The quantitative case studies for this assessment are focused on the air quality impacts from smoke, rather than the full air quality impacts including those from heavy equipment. We've added a footnote to that end in the chapter.
7	P2-6 L11: The word legacy is unnecessary and should be struck; contaminants are problematic no matter their age or source.	Fixed
7	P2-6 L26: I realize this is an existing definition, but this is problematic given human influence on virtually every part of the natural world. Is a fire sparked by a car on the side of a highway in eastern Oregon, which burns non-native cheatgrass in a sagebrush ecosystem that would otherwise not frequently have fire, a "natural event"?	The definition is not perfect, but in this context natural means without humans. But since these ecosystems evolved with indigenous burning some people would include that in the definition. Also, cheatgrass is non-native, making it "unnatural" for this environment.
7	P2-7 L12-15: This sentence should be rearranged to simply its construction.	Fixed
7	P2-8 L17-19: This understates the evidence and implies uncertainty that prescribed fire can achieve these objectives. Suggest changing to "There are decades of evidence that…"	Changed text as suggested.

Reviewer	Comment	Response
7	2.3.3.2: It should be noted that in many arid forests in the western US, forest management practice regulations require that residues from harvest or thinning be treated in reduce fire danger. In many areas, that treatment is achieved through pile burning or (less frequently) broadcast burning. Thinning is often done in combination with prescribed burning, often as a first step.	Added pile burning to description of mechanical approaches.
7	P2-10 L24: This sentence is somewhat awkward because "pine" is not a species, but a genus (Pinus) and a family of trees (Pinaceae). Not all pines depend on fire for reproduction.	Changed text to refer to conifers and some pines.
7	P2-10 L27-29: This can be true, but fires can also lead the loss of nutrients from ecosystems, particularly nitrogen. The supply of nitrogen is often the nutrient most limiting to growth in temperate ecosystems. However, in some cases this loss of nutrients could be helpful for plants and other organisms favored by nutrient-poor conditions.	This section is focused on benefits. The description of all of the positive and negative impacts on nutrients is later in Chapter 2.
7	P2-10 L33: Under the right circumstance this is true, but fires can also increase the dominance of cheatgrass. Also, provide a scientific name (Bromus tectorum).	The original intent was to say that cheatgrass hampers control of fire (the converse is also true, as the commentor states). We've revised the sentence for clarity.
7	P2-12 L30: It is also recognized that fuels treatments can decrease carbon sequestration, but increase the stability (decrease the vulnerability) of the remaining forest carbon. https://ww3.arb.ca.gov/cc/inventory/pubs/wildfire_emissions_faq.pdf	Treatments may reduce carbon storage in the short term but help in the longer term. If fires events occur, the benefits are realized sooner following treatments.
8	Overall, Chapter 2 does a good job "setting the stage" for subsequent chapters. Comments are as follows.	Thank you.
8	Page 2.3. It would be helpful to know earlier in the chapter whether or not the fire-related effects include health impacts.	Not clear to what section this comment is referring.

Reviewer	Comment	Response
8	Page 2.9. The reader is puzzled why over 14,000 assessments have not sufficed to characterize the effectiveness of fuel treatments. The text reports that these assessments have suffered from an "under sampling of fuel treatment effectiveness monitoring, mostly on the smaller fires (less than 1,000 acres)."	The text accurately provides the appropriate context for interpreting the reported results given the lower reporting compliance for smaller fires.
8	Page 2-12, Section 2.3.4.2.3, Effects on greenhouse gas (GHG) emissions. The text should acknowledge that in a natural fire regime, the CO2 emitted through biomass burning is taken up again by the subsequent regrowth of vegetation, with a net impact on CO2 concentrations of zero. Only when a forest is replaced by less dense vegetation – e.g., savannah – are fires are source of greenhouse gases. Indeed, the forests in the western US are likely functioning as unnatural CO2 reservoirs, sequestering carbon due to the decades-long fire deficit in this region.	Please see additional references provided in 2.3.4.2.3 to address this comment. In addition, it is important to recognize that site matters along with wildfire severity. Carbon sequestration is a temporal process not static and will change with disturbance, regenerations, succession, etc.

Table 4. Reviewer comments on Chapter 3 (Chapter Specific Charge Question #3)

Reviewer	Comment	Response
4	This is not my area of expertise, but the chapter seems to provide an adequate introduction. Like other chapters in the report, it is confusing that some of the content is general overview, while some is specific to the case studies, and these are somewhat jumbled. For example, 3.1.1 is specific information that applies to the case studies.	Additional sentences were added to the introductory paragraph of section 3.1.1. to clarify the connection with Ch5. [pg 3-6. ln 2-5 and 13-14]
5	Page 3-7 line 24: European settlement	Added "European" [pg 3-7, ln 26]
5	Section 3.1.5 – Since this is touched on in the next section, shouldn't there be a discussion in this section on the role of insect and disease outbreaks in changing fire regimes?	Changed title of section 3.1.5.4 to include biological disturbance agents. Added sentences and references Pg 3-9, ln 10-18
5	Page 3-9 section 3.2: This paragraph seems misplaced. There instead should be a subsection on use of wildfire as a land management approach to reduce fire risk. The introduction to this section should introduce the various land management approaches to reducing fire risk – fuel treatments, prescribed fire, wildfire.	Re-cast the introductory paragraph of the section [Pg 3-9, ln 34+]
5	Page 3-9 lines 18-21: This language is taken almost directly from Young et al. 2020 (Effects of policy change on wildland fire management strategies: evidence for a paradigm shift in western US?) without attribution. This would also be a good paper to cite here to show the growing use of strategies other than full suppression after the 2009 policy guidance. Young J.D. et al. 2020. Effects of policy change on wildland fire management strategies: evidence for a paradigm shift in the western US? International Journal of Wildland Fire 29: 857-877.	Reference added

Reviewer	Comment	Response
5	Page 3-9 section 3.2.1: This subsection is not needed. Instead, parts of it could be incorporated in an introduction to the section on land management approaches to reducing fire risk.	This section introduces the widespread fire deficit in the west as a result of long-term fire suppression--an important concept. The title of the section was renamed to reflect that importance. [Pg 3-10, ln 3]
5	Section 3.2.2 – This is repetitive with section 3.1.5. Some of what is in this section could be included in section 3.1.5 (e.g., cultural burning). Otherwise, this section should focus on land management approaches to reducing fire risk.	Section 3.1.5 presents how fire regimes have changed from pre-European settlement to present. Section 3.2.2 discusses current practices and the effect on fire behavior. Moved the discussion of pre-European forests and indigenous practices from section 3.2.2 to 3.1.5 [Pg 3-7, ln 26 to Pg 3.8, ln 8]
5	Section 3.2.2.4 – see comments related to page 3-9. I don't agree with the language stating this is mostly limited to wilderness areas and national parks. Young et al. 2020 shows that strategies beyond full suppression are becoming much more common in general. Consider calling this section "use of wildfire" rather than just natural ignitions, to be more consistent with the previous chapter.	See response to comments on Pg 3-9. Change title of section 3.2.2.4 to "Use of Wildfire."
5	Page 3-16 lines 28-31: It would be so much more powerful if there was greater information on the fuel treatment activities. How many acres were treated and when? Can these be displayed on the map? This would be more informative than the modeling scenarios, since those are already shown elsewhere in this report.	These details are included in Ch5. Added sentence directing the reader to Ch5 [Pg 3-16, ln 13-14]
5	Page 3-21 lines 1-2: change to where wildfires can be safely managed to achieve resource benefit.	Words added to Pg 3-21, ln 2

Reviewer	Comment	Response
7	This chapter provides a broad background that is important context for the understanding the Rough and TC-6 fires. I think this chapter is well-written and complete except that while the “historic” conditions here are well described, there is no time period identified for when these conditions occurred. I have a number of comments, but these are minor remarks.	Widespread Fire suppression started at the beginning of the 20th Century. "Historic" refers to conditions prior to widespread European settlement of the west in the later part of the 19th Century. Added words to define "historic" [Pg 3-4, ln 8-9]
7	P3-1 Line 10-13 notes that climate is a key driver of fire regimes, but should have also mentioned that fire regimes are also strongly influenced by human actions, including those of indigenous people.	Added sentence at Pg 3-1, ln 13 to point out human influence on fire regimes
7	P3-3 L2: Rather than visual or measured, I think you mean qualitative and quantitative. If you count something you see with your eyes, that is both visual and measured.	Recast sentence [Pg 3-3, ln 2]
7	P3-3 L8-9: I disagree with this statement. It is relatively easy to estimate flame length, which is a proxy for fireline intensity. However, estimation of duration and actual intensity are of similar difficulty.	Recast sentence [Pg 3-3, ln 8-10].
7	P3-4 L8: Scientific name should be provided at first use in the report.	First used in ln 2; Scientific name inserted
7	Figure 3-2: It feels somewhat misleading to show a large map extent and show WUI area across all of that map, but only show ponderosa pine distribution across part of that map.	We attempted to provide perspective across the region; particularly in northern California where the WUI is encroaching on ponderosa pine forest in the Sierra and the Coast Range and in southern Oregon
7	P3-6 L4: Here and throughout the report, Douglas-fir should be spelled with a hyphen to denote that it is not a true fir (it is not member of the genus Abies).	Changed to Douglas-fir
7	P3-6 L7-8: This is not true for the ponderosa pine forests that would have been part of the Rough Fire. The lower elevation boundary of ponderosa pine forests in that area abuts forests and savannahs composed to oaks (Quercus spp.) and grey pine (Pinus sabiniana).	Added "while blending at lower elevations to pinyon and juniper woodlands, or savannas of oaks (Quercus spp.) and grey pine (Pinus sabiniana) " to sentence

Reviewer	Comment	Response
7	Figure 3-3: This is an odd choice of photos. (1) These do not appear to be the same locations, making it difficult to make a direction comparison. Photo pairs of the same locations are available. (2) This contemporary ponderosa pine stand 10-15 years after a fire does represent some portion of the landscape, but arguably larger portions of the landscape have not experienced recent fire or have experienced recent fires of greater severity. In short, the contemporary image is not indicative of current conditions.	Reference to the figure in the text was moved to Pg 3-6, ln10. The figure caption was rewritten to emphasize the characteristics of old growth forests subjected to frequent low intensity fire rather than a historical context
7	P3-7 L24: change "settlement" to "widespread Euro-American settlement". Indigenous people had lived in these regions for millennia; European settlers arrived in the 1700s and 1800s.	Recast paragraph starting on Pg 3-7, ln 24.
7	P3-8 L18-20: Relative to grasslands and deserts, the spread of invasive species has been lower. However, I would not describe the abundance of invasive plants within ponderosa pine forests as "minimal". There are numerous published reports of invasive annual grasses in ponderosa pine forests in Oregon and California. Keeley and McGinnis (2007) specifically note cheatgrass invasions were considered problematic in the vicinity of the Rough Fire as far back as the late 1990s. I would also refer you to Kern et al. Forest Ecology and Management 463 (2020) 117985	Edited sentences starting at Pg 3-8, ln33 to incorporate reviewer comments and added recommended citations
7	3.1.5.2: Some mention of the role of humans in igniting fires should be added here.	Added citation and text at Pg 3-8, ln25
7	P3-10 L12-15: I'm confused. An effect of prescribed fire is the lack of advanced fire suppression?	Revised sentence
7	P3-10 L15: Lightning	Added lightning [Pg 3-10, ln 12]

Reviewer	Comment	Response
7	P3-16 L24: I'm confused by "the montane chaparral shrub". Is that a descriptor of bitterbrush? If so, I suggest reconstructing the sentence to improve clarity.	Deleted "the montane chaparral shrub" [Pg 3-16, ln 28]
7	P3-17 L6: Fire should be capitalized.	Capitalized Fire [Pg 3-17, ln 6]
7	P3-18 L9-10: The units here are way off. I think Mg is what is intended. It'd be hard to carry much fire with a couple of grams of fuel per km2!	Changed to Mg [Pg 3-17, ln9-10]
7	P3-18 L13 & L17: These dates do not align and it seems likely that the 2011-2014 should be changed to 2012-2015. However, there is no direct citation given for the tree mortality in the Rough Fire area.	Pg 3-19, ln 13 deleted dates and inserted "prior to the fire."
8	This chapter presents an excellent overview of fire regimes and the vulnerabilities of forests to wildfire after decades of fire suppression. This reader, whose expertise is air quality, learned a lot. The recent fire history of the Rough Fire area was especially enlightening.	Thank you
8	Authors might consider specifying whether the fire regimes described in Table 1 are all natural, or a mix of natural and unnatural regimes. Given the caption to Figure 3-1, it sounds like these are natural regimes.	Pg 3-1, ln 17: "…measure of spatial scale of wildfire in a **natural or quasi natural** condition…"

Table 5. Reviewer comments on Chapter 4 (Chapter Specific Charge Question #4)

Reviewer	Comment	Response
1	My only comment on Ch. 4 would be the need to include a discussion of the NOAA HRRR (High Resolution Rapid Refresh) Smoke model, which provides sub-daily estimates of surface-level PM2.5 from wildfires (including Rx fires). As the HRRR-Smoke model is fine-tuned, it will increasingly play an important role in measuring PM2.5 smoke health impacts. Monitored data will increasingly be complemented with remote sensed data and modeled data on smoke exposure. Some discussion of this in Ch. 4 is warranted.	Since this chapter is focused on measurements, we feel this comment is outside the scope of the chapter. The NOAA HRRR model does use some measurement inputs such as the Fire Radiative Power (FRP) from VIIRS/JPSS-1 discussed in this chapter and may play an important role in estimating downwind $PM_{2.5}$ concentrations/exposures/health impacts once validated using appropriate ambient monitoring and health outcome data. However, if we included a discussion on the HRRR Smoke model this would create a need to discuss other forecast modeling systems which is beyond the scope of this chapter.
2	This section is very informative but hardly relevant to the case studies. The split personality of the report as a whole is most glaring here.	Chapter 4 is intended to provide a baseline understanding on currently deployed/available air measurement technologies, measurement density/resolution, relative data quality, data availability, and measurement gaps for wildland fire applications. We feel this background is critical information for the report audience to contextualize the utility of air monitoring data (or lack thereof) to inform land managers, air quality regulators, and public health officials on the impact of wildland fire smoke on public health. In addition, revisions were made to the organization of the report to help address this comment.
3	Page 4-7, Section 4.2.3, Lines 5, you state “focus of fire management” is it really or is it just a part of the risk management? It seems like smoke is not really the focus.	This sentence was edited to clarify that smoke management from large wildfire events in the western U.S. became the primary focus of fire management, air quality regulators, and public health officials in 2020.
4	For the most part, this chapter covers the subject of air quality monitoring in more than enough detail. In fact, I	As indicated in the response to reviewer #2, this chapter is intended to provide a baseline understanding on currently

Reviewer	Comment	Response
	think that it has too many details that contribute to the unnecessary length of the document overall. For example, is Table 4-1 necessary? Why does this document tell me all the things I can learn from the EPA trends report visualization tools?	deployed/available air measurement technologies, measurement density/resolution, relative data quality, data availability, and measurement gaps for wildland fire applications. Table 4-1 provides specific $PM_{2.5}$ and PM_{10} concentration ranges and their associated level of concern, as well as the associated AQI color. The EPA AQI is the primary method for communicating air quality exposure risk to the public and we believe that Table 4-1 is necessary to provide readers the context for subsequent discussions of public health exposures and the presented AQI color key is useful for interpreting data presented in Figures 4-1, 4-2, and 4-3.
4	One type of air quality monitoring that is not really discussed is PM speciation, such as from the Chemical Speciation Network. This data is useful for apportioning PM to different sources, including wildland fire, and should be discussed.	The EPA regulatory monitoring networks are generally described in Section 4.3.2 (U.S. EPA Routine Regulatory Monitoring Networks) and a reference is provided to Appendix Discussion 4.3 - $PM_{2.5}$ Speciation Monitoring (page 4-10, lines 27-30). The CSN and IMPROVE speciation networks are discussed in detail in the appendix and were placed there to manage the overall length of the chapter (see previous comment from reviewer 4). A general introduction to CSN is presented in the chapter (page 4-10, lines 37-38). The appendix discussion and the chapter recommendation section were edited to further highlight the importance of the speciation networks for $PM_{2.5}$ source apportionment/receptor modeling studies as well as the potential value of adding specific biomass combustion tracer species to the network(s) analytical suite.
4	Page 85, line 33. The statement is true that there are no existing national monitoring programs specifically designed to evaluate smoke impacts from fires. However, this is true of most all emissions sectors. To my	EPA and states have and continue to target specific source types during network design and implementation (e.g., near road networks for mobile source carbon monoxide impacts, sulfur dioxide monitoring near coal-fired utility

Reviewer	Comment	Response
	knowledge, there is no national-scale monitoring program designed to capture any one specific source.	boilers, lead monitoring near smelters and battery recyling facilities, manganese monitoring near iron and steel facilities). The statement concerning EPA's historical lack of focus on wildland fire smoke both in terms of monitoring site location and targeted measurements was intended to highlight an across-the-board structural monitoring deficiency.
5	Page 4-8 line 36 change contribute to contributed	Changed as suggested.
5	Page 4-10 lines 9-12: Consider changing to EPA has established one or more FRMs, including specific measurement techniques and instruments, for measuring each of the six criteria pollutants (U.S. EPA, …).	Changed as suggested.
5	Page 4-10 line 13: consider deleting 40 CFR Part 53	Changed as suggested (removed specific text referring to the CFR but retained the cited CFR reference).
5	Page 4-10 lines 19-21: consider deleting "these FEM requirements are also detailed in 40 CFR Part 53 (U.S. EPA, 2019a), and. Begin next sentence with "A monitor"	Changed as suggested (removed specific text referring to the CFR but retained the cited CFR reference). The paragraph was also edited to highlight the point that FRM requirements include both design and performance elements, while the FEM requirements are solely based upon performance.
6	In my opinion, this section of the report contains plenty of detail.	No response required.
6	One comment – which the authors can consider and which is by no means essential for them to address right now – is the question of "how good of a measurement is good enough?" As a member of the general public living downwind of a fire, does it really matter if the true AQI is 400 and it gets misreported as 300 or 500? Either way it is a lot of PM, and some measurement error doesn't really matter – the tools we currently have available might be perfectly adequate. Whereas for a scientific researcher, very accurate species concentrations measurements might	We agree with this comment. We organized the chapter to highlight this point by discussing the different types of monitoring technologies (FRM/FEM, temporary deployments, remote sensing, and sensors), how they are used to meet their respective monitoring objectives, and discuss associated data quality. Each end user of ambient monitoring data determines their specific accuracy requirements depending on their specific use case objectives. Higher uncertainty may be acceptable for public health officials providing general guidance to the

Reviewer	Comment	Response
	be quite important, and we often don't have those, and even when we do we know the aerosol composition of the plume changes with aging, etc. so one monitor isn't enough. So different goals might necessitate different investments into the monitoring network, and this point could be made in section 4.5 or 4.6.	public for managing exposure and health risks (e.g., AQI of 305 versus 500 are both considered Hazardous and the same guidance is communicated). However, air quality regulators, dispersion modelers validating new smoke models or epidemiologists documenting smoke exposure/adverse health outcome require a much higher level of measurement certainty and QA/QC rigor. The goal of this chapter is to present current available measurement capabilities and their relative data quality.
6	Figure 4-1 – what are the colors? The shapes are explained in the figure description but not the colors.	Figure 4-1 caption was edited to clarify that the color associated with each monitoring site represents the current EPA AQI value.
7	Although I have some experience with air monitoring research, I am not an expert in this field. I found this chapter to be an interesting read and a comprehensive and honest assessment of the strengths and limitations of current monitoring capabilities. The information in this chapter helps inform some of the subsequent approaches and analyses. I thought this chapter was perhaps too detailed, particularly in the discussion of some of the remote sensing techniques that have less direct relevance to public health. However, this information is useful if the purpose of this chapter is to provide a comprehensive assessment of monitoring capabilities.	On balance there was more support for the current level of Air Quality Monitoring detail in the chapter than criticism that it added too much length to the report. As discussed in responses to previous reviewer comments, the authors balanced the level of detail in the chapter and the report appendix to meet the overall expectations of all readers.
8	Chapter 4 does a good job describing current efforts to monitor smoke air quality with in situ sensors, ground-based measurements such as AERONET, and satellite observations. In particular, the challenge of translating aerosol optical depths (AOD) as viewed by satellites into surface concentrations of smoke PM2.5 was well described.	No response required

Reviewer	Comment	Response
8	Figure 4.2. The colors in this figure do not match those of Table 4.1.	The reviewer is correct. EPA created a specific pantone color palate to represent each AQI level of concern that it carries through all communication materials (#349 Irish Green (PMS 3415c), #108 FM Yellow (PMS 102c), #151 Golden Poppy (PMS 151c), #485 Canada Red (PMS 186c), #2627 Pansy (PMS 2627c)). These colors are accurately presented in Table 4.1 and the AirNow website as presented in Figure 4.1. The USFS utilizes a muted color palate for their AirFire tools web site when presenting total cumulative $PM_{2.5}$ as presented in Figure 4.2 presumably to make the figure more intelligible. The figure colors are true to their source material and were not edited by the authors for presentation in the report.
8	Page 4-17. The text describes current efforts to combine satellite measurements of AOD with results from chemical transport models (e.g., GEOS-Chem) to derive surface values of smoke $PM_{2.5}$. Figure 4.3 shows of such an effort for one day in 2020. The reader is curious if efforts are being made to validate such maps of daily surface PM2.5. As the text makes clear, most (successful) efforts to combine satellite AOD and GEOS-Chem results have led to estimates of annual or seasonal mean PM2.5 at the surface, not daily concentrations.	Currently, only limited efforts have been undertaken to validate such maps in a statically robust manner. The approach uses a geographically weighted regression of AOD to surface monitor data and requires an adequate number of independent surface monitors that are not typically available to facilitate the validation of the maps.
8	Section 4.5. A key challenge not mentioned in this section is the difficulty of attributing $PM_{2.5}$ measurements to smoke or to some other species. Even if sensors were placed close to wildfire-prone regions, the challenge of distinguishing smoke from other kinds of $PM_{2.5}$ would remain. Aguilera et al. (2021) used a combination of surface EPA-AQS measurements with HMS smoke plumes to attribute surface PM2.5 to smoke or not-smoke in southern California. But the HMS smoke product, as	In close proximity to wildland fire emissions the impact from the smoke is easy to discern (e.g., signal/noise ratio) when using any measurement technique (e.g., sensors), however further downwind the ability to discern the impact can be very difficult or impossible. The 3rd bullet in Section 4.5 does discuss this issue of not being able to attribute measured air pollution to distant fires "Air pollution concentrations (e.g., $PM_{2.5}$) can be significantly elevated thousands of km away without an obvious

Reviewer	Comment	Response
	the CAIF report rightly mentions, may not reflect surface concentrations. Aguilera, R., T. Corringham, A. Gershunov, and T. Benmarhnia, Wildfire smoke impacts respiratory health more than fine particles from other sources: observational evidence from Southern California, *Nature Commun. 12,* 1493, 2021.	connection to distant fire events." As discussed in a previous response to a comment by reviewer 4, the appendix discussion and the chapter recommendation section was edited to further highlight the importance of supplementing the continuous and filter-based speciation networks with specific biomass combustion tracer species to aid in source apportionment/receptor model efforts.
8	One way to resolve this issue would be for EPA/AQS to routinely measure tracers of biomass burning such as levoglucosan. Other species currently measured – including black carbon and organic carbon – are emitted by both wildfires and other anthropogenic and/or biogenic sources.	This point on biomass combustion tracer species has been added to the appendix discussion, recommendation bullet #2 was edited to focus on continuous biomass combustion tracer species measurements, and a new recommendation bullet #3 was added to focus on the addition of biomass combustion tracer species into the analytical suite of integrated filter-based samples.

Table 6. Reviewer comments on Chapter 5 (Chapter Specific Charge Question #5)

Reviewer	Comment	Response
2	Table 5-2: Inconsistent and/or confusing terminology: "Actual fire", "Actual wildfire", and "Actual prescribed fire" are all in the same table. The report as a whole needs to be edited for consistent use of terminology.	Based on the reviewer's suggestion, the term 'actual' has been removed from the chapter to minimize confusion for the readers.
2	The plots in chapter 5 are poorly formatted. If the row location and column location of a panel in the multipanel plot are informative, why aren't the row and column headers shown?	Based on this comment and similar comments from other reviewers, X and Y scale indicators have been added to Figures 1 and 2 and Figure 3 now includes a scale bar.
2	Figs 5-8, 5-9: Where did scenario to 2a go?	Scenario 2a was very similar to Scenario 2b but slightly smaller so the impacts of that scenario were not shown in this Figure. Scenario 2a impacts are shown in Figure 10 and Figure 11.
2	Fig 5-13: Appears to be missing a row.	For some reason when the report was being finalized this Figure did not get correctly incorporated into the final version of the document. This Figure has been revised so that the Figure and caption match.
2	Fig 5-18: Does color correspond to vertical position? Why? This is very confusing.	The caption for the colorbar on Figure 18 has been updated to more clearly state that the color gradient represents the % contribution wildfire smoke make to the total PM2.5 prediction by the model (other sources also produce PM2.5 in the model like industrial sources and mobile sources).
2	Fig 5-19: Formatting is all over the place.	We will work to ensure the final version of the report shows a correctly formatted version of Figure 5-19.
3	Page 5.2 Section 5.11. Lines 1 /2- What about ignition pattern as a factor for combustion intensity?	We have added text recognizing that prescribed fire ignition pattern could impact emissions.
3	Page 5-10, Section 5.1.5, Lines 5-7, Might want to try and get a copy of the burn plan to attach as a reference.	Based on this comment we have obtained the burn plan and attached it as a reference.
4	The modeling approach is mostly reasonable, as are the inputs developed for fuel loading and emissions. Fire	Emissions for fire emissions are calculated using the traditional approach using area burned:

Reviewer	Comment	Response
	emissions modeling, and chemical transport modeling are only briefly explained here. This is OK, but it is jarringly different from the sometimes excruciating detail of other chapters (3 and 4, for example). It would be good to at least include the equation used to calculate emissions.	Emissions(pollutant)=area burned*fuel_loading(mass of fuel consumed/area)*emission_factor (mass pollutant/mass fuel consumed). The fuel loading is determined by the fuel model such as FCCS and by the consumption model (CONSUME). The emission factors are calculated with FEPS (one of the modules in the Bluesky Pipeline). Text has been added to the emissions subsection to include the general equation for estimating emissions.
4	One troubling point is the last line in section 5.2.5, which states that "fuel moisture is a global parameter that only varies by fire type (wildfire or prescribed)." Fuel moisture has a very significant impact on modeled consumption in the Consume model and thus will strongly affect the resulting emissions and downwind PM2.5 concentrations. What is the justification for using static fuel moistures, and how were they selected? This detail is important to include. The model validation statistics are important and should be in the main text instead of the appendix. They show that this model is only modestly successful at replicating observed PM2.5 and help the reader understand how to assess the results. The population exposure plots don't make sense (the scaling of 1 ug or 1 ppb === 1 person is arbitrary) and should be removed. This topic is better addressed in Chapter 8.	We used the Bluesky Pipeline tool to estimate emissions for both wildfires and prescribed fires. This tool is the most recently available fire modeling tool from the Forest Service and represents the best available science tool for regional scale modeling. However, it does not have a way to include fuel moisture as a dynamic input. Fuel moisture can be specified as fixed values for individual fires or groups of fires through the configuration for different types of fuels. The default WF fuel moisture is 50% for 10 hr, 30% for 1000 hr, 75% for duff, and 16% for litter (The default RX fuel moisture is 50% for 10 hr, 35% for 1000 hr, 100% for duff, and 22% for litter. Adding dynamic fuel moisture as an input is a planned update to the system. Text providing more information about the fuel moisture capability of the BlueSky Pipeline system has been added to the report. Based on this comment, some of the more relevant performance statistics provided in the appendix have been added to the main text of the report. The metrics add to the discussion that the model has limitations based on performance comparing model predictions and observation data.

Reviewer	Comment	Response
	I don't understand how the pile burn emissions exercise fits into the larger study.	The plots that show smoke impacts by population are intended to provide some level of continuity with chapter 8 and illustrate how population exposure changes spatially and temporally which is not covered in chapter 8. The reviewer is correct, the pile burn component of the report is not well connected to the other components. It was intended to provide some context about potential impacts of that type of land management approach. Since those impacts are not well contextualized within the scope of these case studies, the pile burn text has been deleted.
4	Page 119, line 22. Fix link label.	Links were checked and corrected as needed.
4	Figures 5-1, 5-2, 5-3. These maps needs a scale bar. Also the grid is not explained.	X and Y scale indicators have been added to Figures 1 and 2 and Figure 3 now includes a scale bar.
4	Figure 5-4. This map is at too large a scale to be useful and should be zoomed in. It also needs a scale bar.	Text was revised to indicate the close-up view of these fire perimeters is in Chapter 1 and the Figure in this chapter is intended to show the relationship of the fires to nearby population centers. X and Y scale indicators have been added. The Rough fire is now shown with a single mark instead of the daily perimeter contours to avoid confusion since that is shown in the figure in Chapter 1.
4	5.2. How was plume injection height estimated?	Text has been added to 5.2.5 that described the plume rise approach used in this modeling system.
4	Page 126, line 3. This is not quite correct. The original BlueSky framework was written primarily in PERL, with some C and Java; however, the most widely used version of BlueSky prior to BlueSky Pipeline was BlueSky version 3, which was written in Python.	We appreciate the information. Text has been changed to be clearer about the software architecture used in BlueSky Pipeline and we no longer provide details about BlueSky Framework since that is not particularly relevant to the report.
4	Section 5.2.3. This paragraph is repetitive of information provided earlier in the chapter.	New text has been added to this section that helps distinguish it from other sections.

Reviewer	Comment	Response
4	Section 5.2.3.1 explains how the temporal profile for the TC6 case was developed. What about the Rough fire?	Text was added to the temporal profile section (5.2.3.1) that notes the Rough fire used the default temporal profile for wildfires.
4	Figure 5-8. The difference plots should have the same scales between the large and small cases so they can be compared.	Based on this comment, we have made the scales the same for the difference plots shown in Figures 5-8 and 5-9.
4	Figure 5-9. Same as 5-8.	Based on this comment, we have made the scales the same for the difference plots shown in Figures 5-8 and 5-9.
4	Figure 5-12. The units on the lower left plot are incorrect (although I think the population exposure plots should be removed). Why are the scales so large?	Based on comments about the lack of connection between the pile burn analysis and the case studies this Figure has been deleted.
4	Figure 5-12. It is unclear from the text how the pile burn estimates contribute to the case study. Are they included in the health effects portion (chapter 8)?	The reviewer is correct, the pile burn component of the report is not well connected to the other components. It was intended to provide some context about potential impacts of that type of land management approach. Since those impacts are not well contextualized within the scope of these case studies, the pile burn text has been deleted.
4	Figure 5-13. Caption does not match the figures (there is no middle row).	For some reason when the report was being finalized this Figure did not get correctly incorporated into the final version of the document. This Figure has been revised so that the Figure and caption match.
4	Figure 5-16. The meteorological pattern and resulting population impacts are quite different from some other events (e.g., 2020). This highlights the limitations to the conclusions one can draw from this study.	Based on this comment, text has been added to the limitations section at the end of the chapter noting that wildfire impacts could be different than shown in this report if meteorological patterns were different.
5	The modeling approach is reasonable and well described and the authors include an honest assessment of the limitations of this approach, especially as related to the different time horizons of prescribed fire and wildfire. Even with this limitation, given the attention paid to the expected value framework in chapter 2, I was expecting	We appreciate that this type of comparison is of interest based on the preceding chapters discussing the need to balance land management air quality impacts. One way this study attempts to balance air quality impacts of prescribed and wildfire is comparing the cumulative impact on human health which is provided later in the

Reviewer	Comment	Response
	the scenarios with wildfire and prescribed fire to have results presented as a cumulative effects. For example, hypothetical smaller TC6 fire is assumed to be smaller because of implemented prescribed fires. To evaluate expected value of this scenario, wouldn't you need to examine the emissions of the wildfire as well as all the prescribed fires combined, even if they occur over different time periods? Here or elsewhere in the report, I'm seeking some explanation for why each of these scenarios display outputs from individual fires, when there are basic assumptions behind the scenarios that the prescribed fires and wildfires are not acting independently.	report using the BenMAP tool (see Chapter 8). The limitations discussion at the end of this chapter describes the challenges associated with the type of direct comparison described by the reviewer in this comment and how we lacked information about how frequently prescribed burning and how much prescribed burning would need to be done in this region to minimize or eliminate the probability of a wildfire so that we could aggregate the prescribed fire air quality impacts such that they would match the inevitable wildfire if land would not be managed. This study should be considered as a contextual piece that could be a component of a larger subsequent study that could make that type of more direct but complex comparison of air quality impacts due to prescribed fire.
5	Page 5-2 line 18. Carbon should be capitalized	Capitalization for carbon was double-checked throughout the report and changes were made as necessary.
5	Page 5-2 line 19: Should emission factor be defined?	Text has been added to the emissions section that provides a general emissions equation which includes emission factors. This was intended to provide contextual information about the form of the emission factor as a way to define the term.
5	Page 5-4 line 21: suppression and fuels management efforts.	The reviewer is correct, and text has been changed to reflect this suggested change.
5	Figure 5-3: Why isn't the 2019 Rx Fire on this map?	These fires were added to the Figure based on this comment.
5	Figure 5-4: It would be better if the scale of this figure could be more akin to that of figure 5-3.	Text was revised to indicate the close-up view of these fire perimeters is in Chapter 1 and the Figure in this chapter is intended to show the relationship of the fires to nearby population centers.
7	I think the modeling approaches that were used were sound. In general, the assumptions and the source data	We used the Bluesky Pipeline tool to estimate emissions for both wildfires and prescribed fires. This tool is the

Reviewer	Comment	Response
	driving the modeling is clearly described. However, while I see where the meteorological data driving the atmospheric transport is described and I see where the fuel load and type data are described, I do not see any description of the meteorological inputs to the fire modeling (no description of fire weather), and I do not see a description of fuel moisture. Presumably, these are handled in the BlueSky Pipeline/Consume because it is producing estimates of fuel consumption and emissions. While presumably the modeling reflected the conditions of the actual burns, conditions would have to be assumed for the other burns. Some description of these assumptions would be insightful.	most recently available fire modeling tool from the Forest Service and represents the best available science tool for regional scale modeling. However, it does not have a way to include meteorological data or fuel moisture as a dynamic input. Fuel moisture can be specified as fixed values for individual fires or groups of fires through the configuration for different types of fuels. The default WF fuel moisture is 50% for 10 hr, 30% for 1000 hr, 75% for duff, and 16% for litter (The default RX fuel moisture is 50% for 10 hr, 35% for 1000 hr, 100% for duff, and 22% for litter. Adding dynamic fuel moisture as an input is a planned update to the system. Text providing more information about the fuel moisture capability of the BlueSky Pipeline system has been added to the report.
7	P5-18 L8: All land is managed and all USFS and NPS lands should have management plans. Even wilderness lands are managed!	The commenters point is appreciated. We did not intend to imply that some lands in the United States have no type of management.
7	Figure 5-14 needs better labeling, particularly the panels on the left side that are all have the same heading.	The labels for each of the panels has been removed to avoid confusion.
7	Figures 5-15 and 5-16: The color ramps are similar for the absolute concentrations (left panels) and the differenced concentrations (middle and right panels), which is unintuitive given that the scales are quite different. I think it would be easier to understand that the middle panels are lower and right panels are higher if a different color scheme was used.	The same color gradient is used for all plots showing absolute model impacts in the chapter to provide the reader a sense of continuity. The use of blue and red gradients for the difference plots is a common way to illustrate situations where a model prediction is smaller (shown in cool colors) or larger (shown in warm colors) than another prediction.
7	P5-31, L 9-14: It is good to note this limitation because a 12-km grid size does seem like it would be too coarse to accurately model and quantify the impacts of fire emissions on downwind communities.	This sentence has been changed to acknowledge that grid resolution was a key limitation when considering the model predictions on downwind population areas.
7	P5-33, L3: This sentence desperately needs a comma after “population”	The text has been updated based on this comment.

Reviewer	Comment	Response
7	P5-37: Given that there are large population centers near the Rough Fire and that a higher resolution (finer scale) model may be much more accurate, why not also do a finer scale model run instead of only relying on the coarse 12 km grid?	We suggest that finer resolution modeling be done as part of future work at the end of the chapter recognizing this limitation. We did not do fine scale modeling due to time constraints.
8	Chapter 5 lays out the design of the model simulations and presents results in terms of the $PM_{2.5}$ and ozone enhancements from the different kinds of fires – wildfire vs. prescribed, actual vs. hypothetical. Overall the modeling approach is sound, and the authors seem very aware of both the strengths and the limitations of this approach. For example, the chapter mentions how the interannual variability of meteorology is not captured by this approach, and how the spatial resolution of the model may fail to capture steep gradients in both topography and in concentrations. The chapter is also very clearly written, with a nice introduction to the challenges of modeling fires – e.g., the limited knowledge of emission factors, especially from smoldering vs. flaming fires.	We appreciate the positive comments from the reviewer.
8	Section 5.1.3. As mentioned for a previous chapter, it might be helpful to include a table describing the characteristics of the different scenarios and the timeframes of these scenarios.	Table 5-3 contains a list of the difference scenarios, specifics about those scenarios, and the time frame modeled for each of the scenarios.
8	Sections 5.2.1 and 5.2.2. There seems to be some overlap between the two sections. For example, FCCS is introduced to the reader twice. Perhaps some effort could be made to better harmonize this text.	A topic sentence was added to 5.2.1 to be clear about what each of these sections is describing in terms of fuels for wildfire emissions estimation and make them more coherent together.
8	Section 5.2.3.1. This section presents the temporal profile for the Timber Crater Fire. I didn't see a similar description of the profile for the Rough Fire.	Text was added to the temporal profile section (5.2.3.1) that notes the Rough fire used the default temporal profile for wildfires.
8	Page 5.18. This reader is surprised that modeled fuel moisture is not a function of meteorological variables like	We used the Bluesky Pipeline tool to estimate emissions for both wildfires and prescribed fires. This tool is the

Reviewer	Comment	Response
	relative humidity or recent precipitation. Is this typical for fire models?	most recently available fire modeling tool from the Forest Service and represents the best available science tool for regional scale modeling. However, it does not have a way to include meteorological data or fuel moisture as a dynamic input. Fuel moisture can be specified as fixed values for individual fires or groups of fires through the configuration for different types of fuels. The default WF fuel moisture is 50% for 10 hr, 30% for 1000 hr, 75% for duff, and 16% for litter (The default RX fuel moisture is 50% for 10 hr, 35% for 1000 hr, 100% for duff, and 22% for litter. Adding dynamic fuel moisture as an input is a planned update to the system. Text providing more information about the fuel moisture capability of the BlueSky Pipeline system has been added to the report.
8	Table 5.2. The authors might consider adding a footnote to explain that the 1978 and 2001 Timber Crater fires and the 2007 Cornerstone fires are actual fires, occurring in the past. Also the designation of "Timber Crater 1/2" is confusing. The reader thinks "1/2" means one-half.	The reviewer makes a good suggestion, and the Table has been updated to reflect these suggestions.
8	Figures 5.8 and others. A note explaining that the colorbars differ among panels would be helpful.	Text was added noting that the colorbars were different in different panels of Figure 5-8 and 5-9.
8	Figure 5.10. Again a note explaining the different extents of the y-axes would be helpful.	Based on this comment, the Y scales for each row have been made consistent in Figure 10.
8	Page 5.25. The text states that the daily impacts of MDA8 ozone from prescribed fire were sometimes comparable or even larger than that in the wildfire scenarios. The first reason given forthis increase – that the model burned all the fuel in one day – seems unconvincing, as the same phenomenon is not seen for the $PM_{2.5}$ results. Perhaps this reviewer is missing something.	The same phenomenon is not seen for PM2.5 in this assessment because the highest PM2.5 impacts tended to be overnight when the surface mixing layer was lowest. The O3 impacts are totally driven by daytime emissions because O3 only forms during the daytime when solar radiation is present to initiate photochemical reactions. The prescribed fire emissions were concentrated during the daytime hours when photochemical production of O3 happens. Since O3 and PM2.5 impacts peak at different

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		times of the day the diurnal profiles are important and can have differential impacts on PM and O3.
8	Figure 5.13. The caption seems not to match the Figure.	For some reason when the report was being finalized this Figure did not get correctly incorporated into the final version of the document. This Figure has been revised so that the Figure and caption match.
8	Page 5.35. The text points out that the model sometimes overestimates PM2.5 compared to that measured by the sensors. A potential reason given for this overestimate is that the model does not take into account the volatilization of primary organic aerosol (POA). That could be true, althoughPalm et al. (2020) found that much of the volatilized POA actually re-condenses to produce an equivalent mass of secondary organic aerosol. A more likely reason for the mismatch could be thecoarse model resolution, as the authors also note. Palm, B.B. Quantification of organic aerosol and brown carbon evolution in fresh wildfire plumes, *PNAS*, *117* (47), 29469-29477, 2020.	The reviewer makes a good comment. Text has been revised to note that some of the other reasons mentioned for performance degradation were like more important. We also referenced the manuscript suggested by the reviewer as part of the revised text.
8	Section 5.4. This section nicely summarizes the approaches and limitations of the study.	We appreciate the positive comment on the report.

Table 7. Reviewer comments on Chapter 6 (Chapter Specific Charge Question #6)

Reviewer	Comment	Response
1	My only general comment on Ch. 6 is the need to have a dedicated section in this chapter on the health impacts of prescribed fires, specifically. There is now a growing literature on Rx fire health impacts, separate from the general wildfire health impacts literature (see Jones & Berrens, 2021 for infant health and Rx fire; ER visits and Rx fire in Huang et al. 2019; and a discussion of environmental justice dimensions of Rx fire exposure in Gaither et al. 2019). The current focus on the wildfire smoke health literature in the report is too limited and needs to be expanded.	We disagree with this comment. We reviewed the references provided by Reviewer 1, and as noted in Chapter 6, to date there is only one study conducted in the U.S. that specifically focused on the health effects of prescribed fire smoke. The studies referenced by Reviewer 1 represent assessments of the potential public health impacts of prescribed fire smoke which rely on health impact functions derived from studies of wildfire smoke, not prescribed fire smoke. While these studies can provide some indication of overall impacts, they do not represent original research focusing specifically on examining the relationship between prescribed fire smoke and health. The focus of this discussion is on epidemiologic studies that examined the health effects of smoke exposure, not secondary analyses such as those presented in Jones et al. (2021) and Hung et al. (2019). Additionally, some references provided represent commentaries and not original research.
1	Additionally, some discussion is needed in Ch. 6 on the potential differences in public health impacts between smoke from Rx fires compared to smoke from wildfires. A recent piece in Nature Communications by Aguilera et al. would be a good starting point. As would the paper by Haikerwal et al. (2015) that discusses Rx fire health impacts compared to wildfire health impacts. My point here is that smoke health impacts from Rx fires may be meaningfully different than the smoke health impacts of wildfires and some detailed discussion of this is needed in Ch.6. Not all smoke is created equal.	As noted in the response to the comment above, to date there are a limited number of epidemiologic studies that examined the health effects of prescribed fire smoke. The study by Aguilera has been cited in the chapter, but it was not extensively detailed because we identified three major gaps: 1) the manuscript does not clearly indicate how PM from wildfires was separated from the PM from other sources 2) the methods lack details on the calculation of daily rates and risk sets in the health outcome analysis and 3) the analysis is said to have been conducted between 1999 and 2012 yet neither HMS nor PM data date that far back. Additionally, the Aguilara study excludes the

Reviewer	Comment	Response
		months with the highest wildfire smoke exposure which greatly complicates comparison to RX or other sources of emission. Lack of these details prevent us from evaluating the validity of methodological approaches which are critically tied to the main conclusions of the paper. Aguilera et al. also conveys a larger issue with respect to wildfire smoke studies with respect to the appropriate exposure indicator. Within the chapter the discussion is based on the available health effects evidence. On purpose we have not speculated as to whether there are differences in health effects between prescribed fire and wildfire smoke. This is better suited for deliberation when enough research is completed. Lastly, it is important to recognize that a higher risk estimate does not equate to greater toxicity as is suggested by some publications.
1	Figure 6-6: Jones et al. (2016) also looked at the population of people taking action in response to smoke from the Wallow Fire in Albuquerque, NM (see Table 1 of their paper). Suggest their data also be included here.	Data from Table 1 of Jones et al. (2016) were added to Appendix Table 6-1, and included in Figure 6-6 and the corresponding text.
1	Overall, Ch. 6 does a nice job of covering the literature, but several relevant studies are omitted and the literature specific to Rx impacts and health needs a dedicated section in Ch. 6.	We added additional references that have been published since the draft of this report was completed. In addition, we reviewed the references provided by Reviewer 1, and as noted in Chapter 6, to date there is only one study conducted in the U.S. that specifically focused on the health effects of prescribed fire smoke. The studies referenced by Reviewer 1 represent assessments of the potential public health impacts of prescribed fire smoke which rely on health impact functions derived from studies of wildfire smoke, not prescribed fire smoke. While these studies can provide some indication of overall impacts, they do not represent original research

Reviewer	Comment	Response
		focusing specifically on examining the relationship between prescribed fire smoke and health. The focus of the discussion in this chapter is on epidemiologic studies that examined the health effects of smoke exposure, not secondary analyses such as those presented in Jones et al. (2021) and Hung et al. (2019). Additionally, some references provided represent commentaries and not original research.
1	This discussion is good, though I agree that our understanding of how people differentially respond to Rx fires vs. wildfires is a large knowledge gap. We know very little about Rx fire responses/behavioral changes at this point in time. This limits any empirical analysis in BenMAP.	We agree with the reviewer, and this is reflected in the discussion within the chapter. Additional text was added to Section 6.3.4 to further emphasize this knowledge gap.
2	The studies included are appropriate for the chosen endpoints, but the EPA's assessment of which concentration-response relationships are "causal" and "likely causal" is a trailing indicator of the state of the science, in this case by about a decade. There are other endpoints (I'm thinking of neurological and pregnancy outcomes) that should either be incorporated or their absence should be addressed. It should be stated clearly that narrowing the health endpoints to only those used will underestimate the true health impacts of wildfires.	We disagree with this reviewer. The EPA completed the most recent Integrated Science Assessment (ISA) for Particulate Matter in December 2019. The endpoints for which a "causal" and "likely to be causal" relationship are based off the conclusions of that document, which represents the most comprehensive and up to date assessment of the health effects of PM. While we agree that the evidence base for birth outcomes and neurological effects has expanded there are still reasons as to why their quantification is not warranted, For birth outcomes there are still inconsistencies in the evidence base for PM2.5 and remaining uncertainties with respect to the appropriate exposure windows which precludes their quantification. For neurological effects, while the evidence has expanded and contributed to the conclusion of a "likely to be causal" relationship for long-term PM2.5 exposure and nervous system effects in the PM ISA, the strongest evidence is for cognitive effects and

Reviewer	Comment	Response
		changes in brain volume in older adults, of which both endpoints are not easily quantifiable. While it is true not quantifying all endpoints could lead to an underestimation of the overall impacts of wildfire smoke, within this assessment the focus is on those health effects endpoints for which there is the greatest confidence in a relationship with PM2.5 and subsequently wildfire smoke.
2	While much more research on this topic is needed, this section does a good job of incorporating what information exists. However, this is where a thorough discussion of equity issues should be brought in. Information and mitigation actions available to the public may differ widely between socioeconomic groups. Some groups may not know about public health warnings, know where to look for them, be able to read them in their native language, or be able to act on them. Home's air infiltration rates are not uniformly distributed across the population, nor is the money to tighten air envelops or purchase air purifiers. There probably exists some research on air infiltration in homes by SES or race that this report should try to highlight if not incorporate.	We agree with the reviewer that equity issues are important to consider and warrant inclusion in future analyses. However, an analysis and discussion of equity is outside the scope of this assessment. Additional text was added to the description of Figure 6-4 where some of these issues were previously noted, as well as to the first paragraph of Section 6.4.4 that highlights the potential increase in access to interventions currently compared to the previous studies available for this assessment.
4	I'm not sure why this is all in the same chapter. These three sections seem quite different. The first section is very well researched, written, and organized, and I enjoyed reading it. I do not know the literature well enough to comment on if it included every relevant study. The section on actions to reduce wildfire smoke was also well presented, though the evidence there is much more tenuous. The section on ecological impacts was interesting, but outside my knowledge and I have no specific comments.	Revisions were made to the introduction of the chapter to tie back to the conceptual framework and convey why all of this information is presented in one chapter.

Reviewer	Comment	Response
5	I'm not sure why ash impacts are singled out and included in this section and in the conceptual framework. It seems like this should be included in the broader discussion of ecological fire effects.	Presentation of ash was considered alongside smoke in an overall consideration of fire effects. Smoke and ash are presented in distinct subsections that combined addressed indirect effects of fire on ecological receptors.
6	My reading of the literature is that the short-term health effects of PM from smoke are a bit different from the short-term health effect of PM from typical urban sources – the systematic reviews suggests show that smoke is strongly associated with respiratory events (and the consistency across epidemiologic studies of wildfire smoke is remarkable), and that smoke is less strongly associated with cardiovascular events (compared to PM from traffic sources). This seems to be supported by the forest plots shown in the chapter as well. Whereas the intro of chapter 6 seems to suggest that the findings for smoke are similar to what we see for PM in general.	The magnitude of associations for wildfire smoke and respiratory and cardiovascular effects are actually quite consistent with what is reported in the literature for short-term exposures to ambient PM2.5. The text within the chapter makes this point in the discussion of cardiovascular effects. Because of differences in the exposure indicator used between studies of wildfire smoke and ambient PM2.5 it is challenging to make a direct comparison as to whether there are differences in the health effects association that are not solely due to differences in the overall concentrations at which people are exposed.
6	The review of the epidemiologic literature seems solid – the forest plots are good to show how the results from the different studies compare. One thought is that in earlier chapters the report makes a clear point to restrict focus & generalization to Ponderosa pine forests, but the CR functions are coming from U.S. studies where the fires occurred in a variety of ecosystems – presumably because we don't have enough restricted to Ponderosa pine forests, but perhaps it makes sense to justify this explicitly in the report given what is written in earlier chapters.	More often than not the epidemiologic studies examining wildfire smoke do not detail the exact location of each fire. While some studies evaluated in the section occur in areas in or near Ponderosa Pine ecosystems the exposure metrics used to represent smoke exposure preclude their use in the quantitative analysis. We added a sentence in the summary of the epidemiologic evidence to address the point by this reviewer.
6	The section on the public health actions is good, but it's hard to think about how to use this alongside the concentration-response functions described earlier in the chapter with BenMAP. One reason is that in the epidemiologic studies, these exposure reduction actions were already employed (to various unquantified extents)	The exposure reduction sensitivity analysis in Chapter 8 was performed on the main analysis results that utilized ambient PM2.5 concentration-response functions. Ideally in the future such an analysis would utilize wildfire-specific CR functions, and those epidemiologic study results would likely include some exposure reduction

Reviewer	Comment	Response
	in the populations in which the epi studies were conducted. Perhaps this will be clearer to me how the authors use this once I get to the BenMAP chapters, but it is something I was thinking about while reading section 6-3. Another challenge is that Table 6-3 is about in-home exposures, whereas the CR functions are about ambient concentrations.	actions already employed by the population to an unknown extent. We acknowledge that the CR functions relate health effects to ambient concentrations, and the summary table in Section 6-3 incorporates the effect of actions on indoor exposures. However, the CR functions for ambient concentrations also incorporate the effect of differences between indoor and ambient exposures since people generally spend the majority of their time indoors.
7	Sections 6.2 and 6.3 are great. I am not a researcher of the health effects of smoke, but I am familiar with the literature and I think these sections are really excellent syntheses. Section 6.2 is a good concise survey of the available evidence for wildland fire smoke health effects that I think produced a very balanced assessment of the state of the science on this topic. Section 6.3 is the best synthesis of mitigation measures that I've seen. Section 6.4 was well written, but missed some important context and neglected a couple of important environmental effects of smoke. In particular, section 6.4 is missing two components: (1) The ability of smoke to create diffuse radiation, which can increase photosynthesis (2) The effect of smoke on air temperature and vapor pressure deficit.	Discussion of the ability of smoke to create diffuse radiation and increase photosynthesis was overlooked and has been added to the document. The comment on effects of smoke on air temperature and vapor pressure deficit is appreciated but despite consulting numerous databases we found little applicable information on these relationships.
7	P6-1 L2: "ecological benefits" would be better phrased as "environmental benefits", particularly given the potential positive impacts on streamflow. Watershed yield is a critical environmental parameter in the water-limited western US.	Noted but this section is focused on ecological effects on plants and animals, not necessarily environmental benefits
7	P6-3 L8: Comma needed after "exposure"	Revised.

Reviewer	Comment	Response
7	P6-28 L29-30: I'm confused by the redundancy of "particulate matter" in this sentence.	Sentence revised
7	P6-29 L1: "It is"	Sentence revised
7	6.4.2: The effects of ozone on plants tends to be a result of cumulative exposure and uptake, which is relevant here for two reasons. (1) Smoke from wildland fires is highly episodic. (2) Wildland fires tend to burn during episodes of especially dry conditions and during periods of the year in dry (western) ecosystems when growth and carbon assimilation are limited and many plants have senesced; both of these would limit plant ozone uptake. Therefore, although this section does provide a concise review of the effects of ozone on plants, it should be caveated with the fact that wildland fire smoke itself is unlikely to produce the cumulative ozone exposures necessary to create these effects. However, there is potential for wildland fire smoke to exacerbate ozone effects in environments already suffering from ozone pollution.	Ozone considerations have been revised
8	Yes, this section does a good job providing an overview of the health impacts of smoke exposure.The summary of different metric of smoke exposure was helpful.	Thank you.
8	One recent study examining the health impacts of smoke is Aguilera et al. (2021). Also, Liu et al.(2017a) is cited but not Liu et al. (2017b), which investigated the health impacts of smoke on different populations. References listed below. The authors might consider including all three references in the Figures showing odds ratios.	Aguilera et al. (2021) was cited in the section, but not discussed extensively. As indicated in the response to Reviewer 1 in our review of Aguilera we identified three major information gaps which included lack of definition for differentiation of PM from wildfires and from other sources, lack of details on the calculation of daily rates and risk sets in the health outcome analysis and finally lack of details about data (eg. the analysis is said to have been conducted between 1999 and 2012 yet neither HMS nor PM data date that far back.) Lack of these details prevent us from evaluating the validity of methodological

Reviewer	Comment	Response
		approaches which are critically tied to the main conclusions of the paper. Other studies included in the figures clearly provide this information. Liu et al. (2017b) is included in the section, but because stratified results were presented the study is discussed within the text and not presented in summary figures.
8	Page 6-5. The authors might consider mentioning the modeling approach of Liu et al. (2017a), inwhich the modeled $PM_{2.5}$ was calibrated with observations.	The modeling approach of Liu et al. (2017a) is described in detail in the Appendix, which is referenced in this paragraph. The studies specifically cited are those that provided information on model performance.
8	Figures 6-1, 6-2, 6-3. The tiny text is difficult to read.	Measures were taken to try and improve readability of all figures.
8	Page 6-14. The text states that "current evidence does not indicate a difference in the health effectsbetween ambient $PM_{2.5}$ exposure and other source-based exposures, such as wildfire smoke…" However both Liu et al. (2017a) and especially Aguilera et al. (2021) suggest that wildfire smokemay be more deleterious than anthropogenic $PM_{2.5}$.	Text was added Section 6.2 and within the summary section on this point. The studies the commenter mentions focus on differences in the magnitude of associations, which do not equate to differences in the toxicity of smoke compared to ambient PM2.5. This difference could actually be due to the overall concentrations of exposure which vary between the two.
8	However, a discussion of the differences between ash and black carbon particles would have been helpful.	This comment does not pertain to the section on ecological effects.

Table 8. Reviewer comments on Chapter 7 (Chapter Specific Charge Question #7)

Reviewer	Comment	Response
2	Page 7-4 line 11: This is the only reference to crystalline silica in the document. Why is it important?	Thank you for the catch. At the end of the first paragraph of this section (page 7-2, lines 26-29) crystalline silica is mentioned and we added some context on why it is important. "In addition to PM generated by the fire, wildland firefighters must also be protected against exposure to airborne soil dust, which can result in hazardous exposures to respirable crystalline silica that can contribute to fibrous scarring of the lung resulting is decrease breathing ability."
3	Section 7.2.1, Page 7-2, Lines 17/18: Do you have data to support this statement: "The main 17 inhalation hazards for wildland firefighters and other personnel at fire camp". Most data collection has been on the fire line, not at camp.	Thank you for asking for a source. It was a good catch and this statement needed citations. So added the citations: Navarro et al. 2021, Navarro et al. 2019, and McNamara et al. 2012. Navarro et al. 2021 states: "In addition, wildland firefighters, incident management personnel, and camp support crew can be exposed to smoke at incident command posts (ICPs) that support thousands of individuals while off the fire line, which can contribute to a higher cumulative work exposure (McNamara et al., 2012; Navarro et al., 2019)."
3	Would also be good to state in section 7.2.1 that OSHA standard is PM4, not PM2.5 like the general public.	Thank you for the comment. We added a foot note to section 7.2.1 stating: [1]$PM_{2.5}$ is the pollutant size most often discussed in context of wildland fire smoke and air quality regulations. PM_4 is the pollutant size used in the Occupational Health and Safety Administration standards for wildland firefighters.

Reviewer	Comment	Response
3	Section 7.2.2.1, Page 7-3, Lines 26-28: Do you have a source for this? "For example, if the Air Quality Index (AQI) during off-duty 26 exceeds 100 (i.e., orange: unhealthy for sensitive groups) due to PM in the fire camp, this can result in 27 firefighters experiencing continuous exposure to high PM concentrations." Some camps are smokey, but most crews try not to sleep in them if that are smoked in.	Navarro et al. 2021, McNamara et al. 1012, and Navarro et al. 2019 have been added as a reference. The 2021 article states: "Camps, where firefighters rest when off-shift, should not be sited in areas with high likelihood of strong, nighttime inversions that can trap smoke and lead to higher exposure to smoke (McNamara et al. 2012; Navarro et al. 2019)."
3	Section 7.3.2.5, Page 7-13, Line 30: Do they specify wildland "which include arson", would a majority be structure fire arson arrests?	The type of arson is not specified.
4	Though it is outside my area of expertise, this chapter seems disorganized and rough. The two main sections seem quite unrelated. Figure 7-2 is not well explained (and too low resolution).	Text has been added to describe Figure 7-2.
4	Page 210, line 13. This is not a sentence.	No change made. Page 210 not found.
5	Table 7-1: Disaster resilience – should this be disaster assistance?	Yes. Change made.
5	Page 7-11 lines 11-26: This paragraph omits the argument, which some studies support, that fuels treatments can lead to increasing suppression costs because it provides opportunities for more aggressive and expensive fire suppression response. Other studies to consider: Bevel, E.J., C.D. O'Connor, M.P. Thompson, and M.S. Hand. 2019. The role of previous fires in the management and expenditures of subsequent large wildfires. Fire 2 doi.org/10.3390%2Ffire2040057. Loomis, J., J.J. Sánchez, A. González-Cabán, D. Rideout, and R. Reich. 2019. Do fuel treatments reduce wildfire suppression costs and property damages? Analysis of suppression costs and property damages in U.S. National	Text has been modified and includes a number of the citations provided.

Reviewer	Comment	Response
	Forests. USDA Forest Service Pacific Southwest Research Station Gen. Tech. Rep. PSW-GTR-261. Albany, CA. Rideout, D.B. and P.S. Ziesler. 2004. Three great myths of wildland fire management. In: González-Cabán, A. (technical coordinator) Proceedings of the II International symposium on fire economics, planning, and policy: A world view, April 19-22, 2004 Córdoba, Spain. USDA Forest Service Pacific Southwest Research Station Gen. Tech. Rep. PSW-GTR-208, Albany, CA. Thompson, M.P. and N.M. Anderson. 2015. Modeling fuel treatment impacts on fire suppression cost savings: A review. California Agriculture 69: 164-170.	
5	Section 7.3.2.4 – Either here or somewhere in the report, there should be a brief discussion of what types of activities are included under these costs.	Description added to Section 7.3.2.4.
5	Page 7-13 line 28: "In 2019, there were 785,500 prisoners in local prisons" – What is this referring to, the number in prison for arson?	Text added to indicate of all crime types.
5	Page 7-15 line 15: change 'mudslide' to ' flooding and debris flow'	Change made
5	Section 7.3.3.1.4 – Also the costs of dredging reservoirs that experience reduced water capacity from increased sediment transport due to fire.	Impact added to examples listed in Section 7.3.3.1.4
6	I don't have comments on this chapter. While it's undeniably true that these are real issues, they are separate from the air quality and health impacts work that comprise the new science that this report is contributing to the literature. I get that the authors are trying to be holistic and encompassing with this report, but in some ways it distracts from the new work that was actually done. I paged through it to get to Chapter 8, which is the	No changes made. Report organization being address elsewhere.

Reviewer	Comment	Response
	chapter that (in my mind) should logically come after Chapter 6.	
6	Some of the sections in Chapter 7 are terse (e.g., 7.3.3.1.3). Even so, I am not convinced that expanding Chapter 7 would meaningfully add to the value of the overall report.	No changes made
7	This chapter discusses numerous aspects of fire-related damage. The coverage of these topics is broad and often brief. However, I don't disagree with this strategy and I think the text provides sufficient depth. I observed only a few concepts that had been omitted or described insufficiently. First, there should be some discussion of structure hardening as a mitigation measure. While the focus of this chapter seems to mitigation of fires on wildlands, inclusion of structure hardening would seem appropriate given the inclusion of defensible space because both are about limiting ignition to build infrastructure. Second, the description of hydrologic impacts of fire could be expanded to be more robust, as detailed below.	Structure hardening is included under 'Fuels Management' and in combination with the discussion on defensible space on pages 7-11 & 7-12.
7	In late 2020, the California Council on Science & Technology produced a report on the costs of wildfire that would be a very relevant contribution to many aspects of this chapter.	Thank you. This report has now been cited in the chapter.
7	7.3.3.1.5: In areas experiencing extensive wildfire, the sudden surge in timber availability from salvage logging can saturate local markets (mill capacity). This has two effects (1) It decreases the immediate value of timber from unburned areas and (2) It can limit opportunities and financial incentives to conduct salvage harvests.	The cited paper (Butry et al. 2001) captures short- and long-term price and quantity dynamics.
7	P7-16, L12: Spelling: Hayman, not Haymen	Change made

Reviewer	Comment	Response
7	P7-19 L30: This section neglects to mention the decrease in precipitation interception created by the loss of vegetation and plant litter material. Interception of precipitation can have a tremendous effect on both the quantity and timing of water delivery to the soil surface and subsequent run-off.	Made this change. Added mention of interception as a factor in increasing runoff.
7	7.3.3.2.5 The section on Water Resources neglects to mention that low and moderate severity wildfires can have a positive impact on downstream water users because water quality impacts may be low, but the decrease in vegetation can increase the supply of water (stream flow).	Made this change. Added a few more sentences describing the variation in effects with severity. Added a sentence noting the potential for positive outcomes in the case of lower severity fires.
8	The reviewer has little expertise in the topics discussed in this chapter. However, the descriptions of the costs and benefits of fires seemed relatively clear. For example, the authors point out that low-intensity prescribed fires coupled with mechanical thinning can reduce the risk of catastrophic fire, and thus lead to a net benefit. The chapter also makes clear the resistance that some landowners have toward prescribed fire.	Thank you.
8	Figure 7-1. Axis labels are too small to read.	Figure has been revised for readability
8	Section 7.3.1. This section was hard to follow. The notion of prefire suppression is introduced but not defined until later in the chapter. It wasn't clear what the difference is between C+L and C+NVC. How do prescribed fires fit into Figure 7-2?	A definition for NVC is now included. Prefire suppression activities are now defined to include fuels management.
8	Section 7.3.2.3. Do suppression efforts include prescribed fires?	Prescribed fire is listed under Section 7.3.2.2.1 Fuels Management
8	Page 7-15. The text mentions that trees sequester carbon, and that this carbon can be released during burning, implying that forest fires can affect CO_2 concentrations. The text should acknowledge that the regrowth of forests	Text updated to include statement that trees also release oxygen.

Reviewer	Comment	Response
	can draw CO_2 levels back down, with a net zero impact of fires on CO_2.	
8	Page 7-19. Two more recent papers that predict increasing fire under a climate change regime include Ford et al. (2018) and Li et al. (2020)	After careful review, the citations provided by the reviewer are beyond the scope of this chapter.

Table 9. Reviewer comments on Chapter 8 (Chapter Specific Charge Question #8)

Reviewer	Comment	Response
1	I did not thoroughly review Ch. 8 (instead I focused on the Chapters that I was directly asked to review). However, I will note that I did not see Jones et al. (2016) or Jones & Berrens (2017) cited in Ch. 8; both also use BenMAP-CE to evaluate wildfire smoke health impacts in the Western US. I would think they should be included in this chapter as background (or in another chapter, if more relevant).	Thank you for your comment. We now cite each paper in the introductory paragraph.
1	I will also note that in section 8.2.3. it appears that the effect coefficients used are from the general air quality and health literatures and are not specific to the wildfire smoke and health literature. Suggest that the authors review Aguilera et al. (2021) in Nature Communications and also see Jones et al. (2016) for why smoke from wildfires may be different such that using general air quality coefficients may be incorrect. It is at least worth commenting on in the report (if not more fully incorporating wildfire smoke-specific coefficients).	Thank you for this comment. As a means of addressing the uncertainty associated with the potential differential effects of wildfire-originating particles, we separately perform a sensitivity analysis. In that analysis we quantify effects using concentration-response parameters from epidemiologic studies of wildland fire events.
2	Page 8-4 lines 28-34: The reasoning for using the short-term effects in one case study and the long-term effects in the other deserves a bit more explanation.	Thank you for your comment. We now clarify why we quantified PM-related effects using concentration-response parameters from both short-term and long-term studies.
2	Figs 8-1, 8-2: How are the filled circles and empty circles different? Needs a legend.	Thank you for this comment. We added a legend to the figure to clarify what the open and filled circles represent.
2	Figs 8-6. 8-7: What is being counted here? What do these numbers represent?	Figure titles and captions have been revised to improve clarity.

Reviewer	Comment	Response
4	The approach for the main BenMAP analysis is appropriate, but the results are limited in applicability. The case studies are quite narrow. Not only can they not be broadly applied to cases in other locations and ecosystems, they can't really be applied to the same locations for different dates. A more statistical approach, looking at a wide range of fire locations and weather patterns would provide a more useful quantification of the differences between prescribed burns and wildfires. The resulting costs are highly dependent on wind direction and meteorology generally. Perhaps this is the biggest takeaway from the study for me. The air quality benefit of simply being able to select the meteorological conditions for prescribed burning can be huge, and I think is not stressed enough in the study.	Thank you for this feedback. We agree that there are limits to the generalizability of this analysis, as there are for all human health risk assessments of air pollution events. Our analysis was constrained by the time and resources available to simulate both emission and air quality changes.
4	It is very difficult to compare the results of the sensitivity analysis (section 8.3.2) from those of the "main results" because they are presented so differently. It would be very helpful for those to be parallel or, even better, on the same graphic or table. I am personally better able to understand the graphical presentation, such as in Figure 8-1, than the tabular presentation of Table 8-2.	Thank you for your comment. We report both tables and figures as a means of reporting the same estimated impacts using two alternative formats.
4	Page 236, line 14. Fix broken link label.	Thank you for this feedback. We have confirmed that the links are active.

Reviewer	Comment	Response
5	My comments for this chapter are very similar to that of chapter 5. While the modeling approach seems appropriate, it don't understand why the effects of the smaller wildfires and prescribed fires are not assessed in a cumulative manner, to be more consistent with the expected value framework. It would also make more sense to me if this chapter were to follow chapter 5, as it is an extension of the modeling effort presented in that framework.	Thank you for this feedback. We quantify the human health impacts attributable to wildfire-related changes in PM and ozone as discrete events. This approach is consistent with the Agency's established methods for quantifying air pollution impacts.
6	Major comment (repeated from earlier in the document): I was surprised to see the list of concentration-response functions used in the "primary" analysis were from studies of urban air pollution. It's fine, but it feels out-of-whack with Chapter 6, which didn't really comment on these studies (at all), but instead focused on the studies of wildfire smoke. Also, when I read 8.2.3, I didn't understand why there were CR functions for long-term PM exposure being used in this analysis – I think better justification for this is warranted – scientifically, I don't understand the rational for applying CR functions for long-term PM exposure to a ~60 day fire event. Also, some of the CR functions (e.g., Katsouyanni et al. 2009) aren't from the US, which seems at odds with the focus on US studies in Chapter 6.	Thank you for these comments. We quantify PM-attributable deaths and illnesses using concentration-response parameters from an array of epidemiologic studies including those conducted from total PM and those conducted using wildfire PM. This approach gives readers insight to the sensitivity of this assumption. With respect to long-term and short-term effects, we now more clearly describe our rationale for this analytical choice. Finally, we selected a U.S.-based concentration-response parameter from the Katsouyanni et al. (2009) analysis.

Reviewer	Comment	Response
6	Table 8-6…are the authors assuming that the prevalence of these actions in the studies that provided the CR functions is 0%? If so, that assumption is wrong for the studies of wildfire smoke health associations…although I guess the authors could argue that by using the CR functions from the urban air pollution studies that it's a reasonable assumption. But that sort of argument also highlights the disconnect between Table 8-6 and the health impact estimates that are ACTUALLY being generated vs. the ones that we wish we were in a position to generate…	The exposure reduction sensitivity analysis was performed on the main analysis results that utilized ambient PM2.5 concentration-response functions. A sentence was added to clarify this and note that ideally in the future such an analysis would utilize wildfire-specific CR functions, and those epidemiologic study results would likely include some exposure reduction actions already employed by the population to an unknown extent.
6	I don't want to be too critical about Chapter 8 – I think it's great work, and there is value in understanding the relative magnitude of differences in impacts across the scenarios (getting the numbers right is scientifically interesting, but also a lot harder to do, and ultimately may not be necessary to inform forest management practices). Using the estimates from the epidemiologic studies of wildfire smoke won't necessarily get better estimates, since the literature is smaller and also the random errors are larger owing to smaller sample size. But it does have the advantage of being a bit more logically connected to the science, particularly for some of the sensitivity analyses. The authors are upfront and transparent about this in the Summary, which is good.	Thank you for this feedback. We agree that the sensitivity analyses give additional insight to the magnitude of PM-related risks attributable to wildfire events.
7	P8-4 L31-34: It is true that the Rough Fire lasted for multiple months, but most of the population exposure (Figure 5-17) was limited to a few distinct episodes. Would combining the short-term exposure effects of these episodes have resulted in stronger or weaker effects relative to modeling the effects of long-term exposure?	An alternative analytical approach would have been to quantify the cumulative effect of the Rough Fire than discrete episodes. However, given that the concentration-response relationships are approximately linear, the count of deaths and illnesses from the cumulative event should approximate the size of the deaths and illnesses summed across the individual events.

Reviewer	Comment	Response
7	Figure 8-1 and Figure 8-2: Some of the symbols are empty and some filled, but I don't see any text explaining the significance of this. Please explain or change.	Figures revised to note symbols.
8	The authors take a very reasonable approach to estimate the health effects of the Rough and TimberCrater Fires and possible scenarios for both these fires. Writing was very clear, and the bullet list of the different fires and scenarios was helpful. This reader was glad to see a distinction made between the long- and short-term health effects of fires.	Thank you for this feedback.
8	Table 8-1 and Section 8.3.2. The text states that concentration response (CR) functions for wildfire-specific $PM_{2.5}$ were applied in the sensitivity studies, and the discussion of such functionsin Chapter 6 is referenced. But there exist many such wildfire-specific CR functions, as Chapter 6reports. The reader wonders which of these many CR functions were applied here.	Thank you for this feedback. Section 8.2.3 summarizes the epidemiologic studies supplying the concentration-response parameters used to quantify risks.
8	Section 8.2.6. This section introduces the concept of Value of a Statistical Life (VSL), and more information is provided in Section 8.3.1. Perhaps the authors would consider consolidating this text. Not all readers are familiar with VSL. Does VSL vary with age?	We now more clearly describe how to interpret VSL and indicate that it does not vary with age.
8	Figure 8-1. A note about the meaning of the filled and open circles would be helpful.	We added a figure legend to clarify what the filled and open circles represent.
8	Table 8-6. The caption should make clear what is meant by "impacts." It took this reader some time to realize that "impacts" referred to the sum of ER visits, hospital admissions, and deaths foreach scenario – i.e., the sum of counts going across Table 8-2 for the actual fires and scenarios.	Thank you for your comment. We have revised the table title for clarity.

Reviewer	Comment	Response
8	Section 8.4. The impacts of the actual Rough Fire are large – 80 deaths due to long-term effects and $3 billion in costs. The summary may want to quote these values in an effort to emphasize thehuge cost of wildfires to human health and welfare.	Thank you for this feedback.

Table 10. Reviewer comments on Chapter 9 (Chapter Specific Charge Question #9)

Reviewer	Comment	Response
1	p.9-1, lines 5-8: grammatical errors. Reword.	Revised.
1	p.9-1, second paragraph: I think the report is underselling how consequential the rather strong assumptions made are at affecting the results. I agree that expert judgment was used, but the required assumptions were both many and were very strong, in my opinion. Simply making a few other assumptions (that would also be expert, in my opinion) would likely change the results by a lot (e.g., using wildfire-specific CR function beta coefficients, looking at an actual Rx fire instead of a hypothetical one, etc.). Suggest that the statement "required assumptions and decisions based on expert judgment" on line 18 be re-worded to convey just how strong some of these assumptions made were. Overall, the report comes across as a little too authoritative for my taste when, in reality, so much remains unknown and so many assumptions were made (where equally justified assumptions could have been made and that would have affected the results).	We revised the paragraph slightly to make it clear that "many" assumptions and decisions governed the assessment.
1	p.9-2: Are there plans by the EPA, USFS, and others to conduct similar investigations on the other components of the conceptual framework (e.g., direct fire effects, ecological effects, other health effects, non-health impacts on society, etc.)?	Future work will expand upon this initial effort.
1	I enjoyed the detailed summaries of the work performed for the TC6 and Rough Fires (sections 9.2.1 and 9.2.2). I found them useful and the discussions to be relevant when contextualizing this work within the larger literature in this area.	Thank you.
1	Figure 9-4 (which is the same as Figure 2-1) should be updated per my earlier comments on Ch.2.	Revised.

Reviewer	Comment	Response
1	Section 9.3.2: In my mind, the main overarching limitation is that the analysis performed in this report does not address the larger question as to the intertemporal benefits and costs of Rx fire. Using prescribed fire generates immediate costs on society (in terms of smoke health impacts), but, also generates long-term benefits to society (in terms of reduced future wildfire severity and risk). The long-term benefits also include the potential for reduced future smoke health impacts from wildfires occurring on Rx lands. This intertemporal benefit-cost analysis is needed in future work to address the role of Rx fire within the larger fire policy context. Net present values will be needed to do this (which this report also does not consider). Figure 9-5 begins to get at this, but it's missing the smoke health component and the role that Rx fires today have on future emissions and future health impacts through wildfire severity. The discussion on p.9-15 is a good starting point, but must more emphasis should be placed on the critical need for future work to address the smoke health tradeoffs between wildfire and Rx fire.	We agree that future work needs to capture this intertemporal component that the reviewer mentions. Revisions were made in the paragraph mentioned by the reviewer to note the health component from smoke which was not clearly articulated.
1	Another overarching limitation that should be expounded upon in Ch.9 is that we frankly do not know the full extent of the economic costs associated with smoke exposure. Yes, premature mortality and morbidity, but what about impacts to the labor market, education, test scores, recreation and exercise, obesity, and minor effects on people such as headaches and slightly reduced productivity? There are many dimensions of smoke impacts that we simply do not know and need data to fill these gaps. Suggest that some of these other dimensions are discussed, specifically, as avenues for future work.	A paragraph was added within this section to address this point.

Reviewer	Comment	Response
1	p.9-20, lines 35-38: The suggestion for a centralized respiratory specific to prescribed fires is an excellent one. We need a NIFC for Rx fires, complete with start/end times, acres burned, spatial characteristics, etc. for all Rx fires in the US each day. Fully agree with this recommendation. Maybe EPA or USFS can look more into collecting such data. We have to begin to get a handle on the actual smoke health impacts of Rx fires that occur more often than wildfires. Data is key to this.	Thank you.
2	Fig 9-1: Shouldn't this be in the modeling chapter?	The figures included in Chapter 9 for each of the case study areas are included within this chapter to put the results of the modeling analysis into the proper context.
2	Section 9.3.3: There is a research gap on how equity intersects with exposure, public health information delivery, and access to protection and mitigation actions.	We agree with this point, but it is outside the scope of this assessment. However, this point was incorporated into the discussion in earlier chapters regarding mitigating and reducing exposure.
3	I enjoyed this final discussion in the paper. Really will help lay out options for additional discussion on both human and forest health.	Thank you.
4	The synthesis is well written and does a good job of highlighting the strengths and limitations of the assessment.	Thank you.

Reviewer	Comment	Response
5	Page 9-1 lines 20-28: This is a good description of the intent of the report and I wish this had been articulated in this manner earlier in the report. I think the report overall however, fails to fully meet the goal of describing "the state of the science with respect to implementing this framework with the goal of employing the best available science and data to estimate many of those impacts and goals". Many of the chapters do not explicitly address the framework. The authors should carefully review each chapter, especially those not pertaining to the novel modeling approach, with this larger goal in mind.	Revisions were made in the introduction of chapters and the order of some chapters changed in order to address this comment.
5	Page 9-13 Line 20: This part of the conceptual diagram is very confusing. What is meant by the ability to mitigate the direct effects of wildfire? I'm assuming this is referring to the line that goes from wildfire to ability to mitigate impacts to non-smoke fire impacts. Is this referring to suppression actions, wildfire use for resource benefit. That flow in the diagram doesn't make a lot of sense and I don't recall seeing a good explanation for what it is referring to.	The conceptual framework diagram was revised, and this box no longer exists.
5	Page 9-13 line 21: Why are these considered "nonfire effects"? They are certainly related to fire.	Within the report we tried to delineate between effects directly from the fire burning on the ground, the smoke effects of fire, and then the effects that are not directly from the fire itself or smoke, which we termed as nonfire. We clarified in the text.
5	Page 9-13 line 23: It seems strange to me to pull out ash deposition as such a prominent fire effect in the conceptual diagram.	Ash deposition is captured in the ecological effects discussion which is why it is captured in the conceptual diagram.

Reviewer	Comment	Response
5	Page 9-15 middle of last paragraph: Consider this edit: "although prescribed fires may reduce both the ignition probabilities and severity of fires, they produce smoke that may, or may not, mitigate the smoke output of a potential future wildfire"	We revised the sentence to improve clarity.
6	My feeling is that Chapter 9 is a nice summary of the information presented within this report. I really don't have comments here – I think it is well-written and comprehensive. My understanding is that the datasets for prescribed fires are lacking and not systematically collected, and that this is really a big limitation for the air quality modelers. I appreciate that this is mentioned in Section 9.5 as well as in the Executive Summary.	Thank you.
7	Chapter 9 is an effective synthesis, though the length and breadth of the report makes it difficult to provide much substantive information about the individual chapters. I think the emphasis on (1) the main conclusions regarding the smoke produced in these fires and the subsequent public health effects (2) the limitations of this work (3) research gaps, was appropriate.	Thank you.
7	I'm not sure the Introduction section (9.1) adds much value because it restates what was previously written and then simply outlines the rest of the chapter.	While we agree that in some ways the Introduction restates the goal of the assessment overall, it also starts to tie everything together which is the goal of the integrated synthesis.
7	Figure 9-1: What are the error bars? Standard error? 95% CI? Other?	The figure was revised to clarify.
7	Figure 9-2: What are the white portions of the bars?	A footnote was added to define the white bars.
7	Page 9-15: This text is excellent, important, and should be elevated to more prominence within this analysis.	Thank you. We have attempted to include portions of this text in other parts of the assessment where it was appropriate.

Reviewer	Comment	Response
7	P9-19 L1-3: Rephrase to "As human development extends further into fire-prone wildlands, it can lead to a change in the composition…" The wildfires have (essentially) always been there. Humans and their stuff are now in the way of those fires.	Thank you for this suggestion.
7	P9-19 L33: I think "can" should be deleted from this sentence.	Revised.
8	Chapter 9 does a good job synthesizing information in this document, including a description of the approach taken and the results obtained. The rationale for the modeling approach is clearly laid out, and the background information on prescribed fires in the Timber Crater area is detailed. There is also a nice summary of fire reduction efforts around Timber Crater. The limitations of the study and data gaps are well described.	Thank you.
8	The authors might consider including here a more quantitative description of the various impacts of the two fires. Those readers who cannot peruse every section will expect the summary to quantify some of the public health impacts reported in Chapter 8. For example, the public would likely be astonished to learn that the Rough fire may have led to as many as 80 deaths and $3 billion in damages. The take home message that prescribed fires can substantially reduce morbidity and mortality from fires, especially in populated areas, should be more strongly emphasized.	Thank you for this comment. We revised the text to include some more overall quantitative information from the BenMAP analyses into the TC6 and Rough Fire discussions.

Reviewer	Comment	Response
8	Section 9.2.2. As stated above, more quantitative information on the impacts of the Rough fire would be appreciated by readers. Page 9-9 states that the hypothetical scenario yields a 40% reduction in fire "impacts," but these impacts are not defined. Is this meant as the sum of emergency visits, hospital admissions, and deaths? Also effective would be a statement of the number of lives saved in the smaller-fire scenario.	We revised the text to include more quantitative information to convey differences between the different scenarios for both case studies.
8	Section 9.2.2. This section seems wordy and hastily written and so could be more carefully written.	Made some revisions to improve clarity.
8	Page 9-9. The text states that fires occurred more frequently in the Sierra Nevada in the past relative to today. It would be helpful to know just how frequently such fires occurred.	New text was added to address this comment.
8	Page 9-10. The text states: "Impacts to air quality from these fires…" What is meant by "these fires"? Fires prior to 1900? In any event, the text further states that these fires would have been similar to the prescribed fires because they spread more slowly *and* because less fuel was availableto burn. But isn't the spread related to the fuel availability? Or is there another reason for the slow spread? Further down the page, the text states "…daily emissions were much lower compared tothose during the Rim fire…" Again, are these daily emissions from the pre-1900 fires?	Yes, we mean fires prior to 1900. In addition, we note that fires prior to 1900 would likely have been similar, we did not state would be similar. In addition, we state that this similarity would be due to the pre-fire fuel likely being less. Lastly, we revised the last sentence to clarify that the statement was in reference to emissions from prescribed fires and fires that yielded positive resource benefits as detailed in Long et al. (2018).

Reviewer	Comment	Response
8	Page 9-11. The text states: "In summary, in dry forest ecosystems, such as in the area of the RoughFire, these landscapes will experience some combination of prescribed fire and wildfire." This seems to be a weak conclusion, and the authors might consider strengthening the concluding remarks. The health impact of the Rough Fire is probably much larger than the public expects, and an emphasis on the benefits of prescribed fires for public health seems warranted.	Thank you for catching this oversight. We added an additional sentence to conclude the section: "In the future, the degree to which the mix of prescribed fire and wildfire for resource objectives can be applied on these landscapes will likely determine whether the impacts of future large-scale fires and the corresponding smoke produced can be limited."