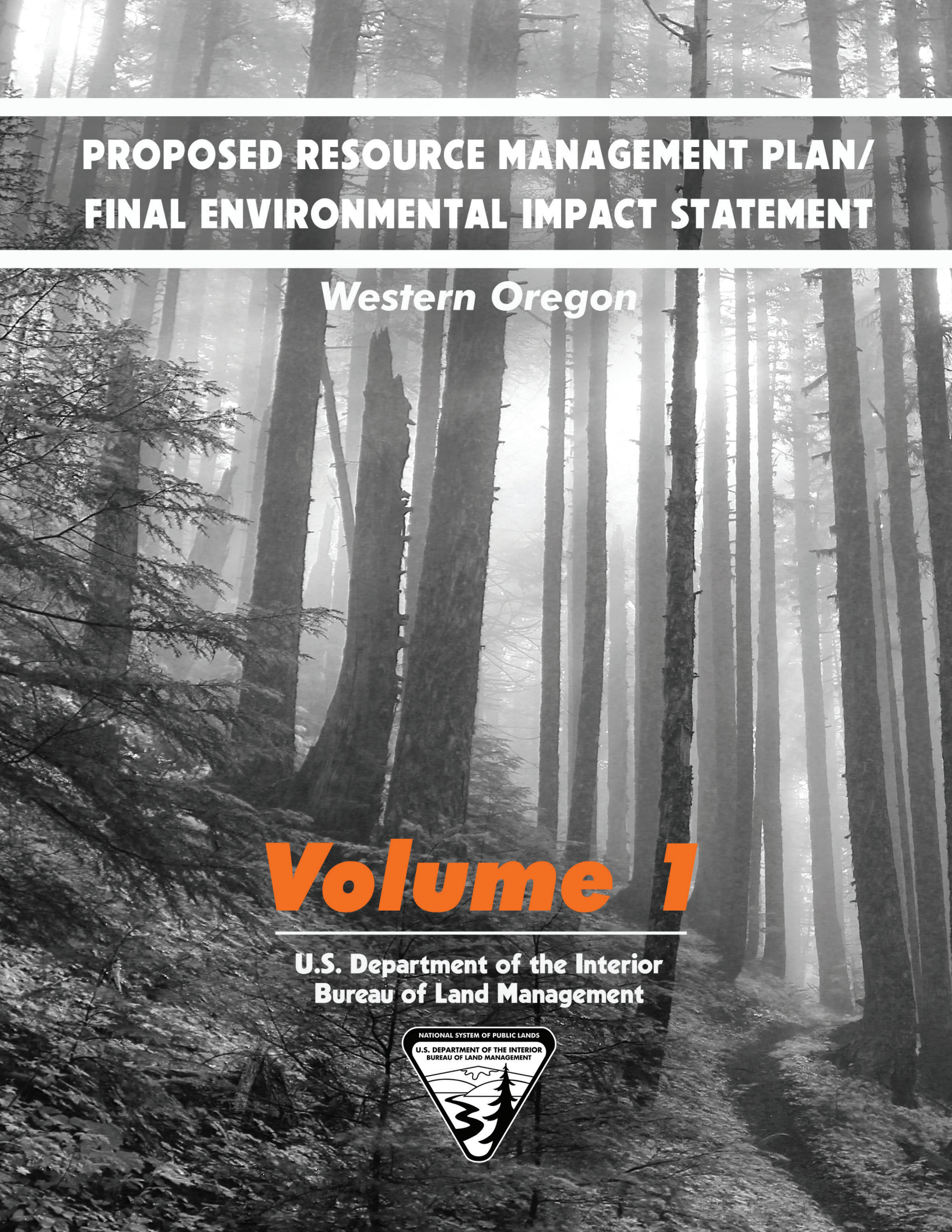

PROPOSED RESOURCE MANAGEMENT PLAN/ FINAL ENVIRONMENTAL IMPACT STATEMENT

Western Oregon

Volume 1

U.S. Department of the Interior
Bureau of Land Management

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

The BLM manages more than 245 million acres of public land, the most of any Federal agency. This land, known as the National System of Public Lands, is primarily located in 12 western states, including Alaska. The BLM also administers 700 million acres of sub-surface mineral estate throughout the nation.

The BLM's mission is to manage and conserve the public lands for the use and enjoyment of present and future generations under our mandate of multiple-use and sustained yield. In fiscal year 2013, the BLM generated $4.7 billion in receipts from public lands.

blm.gov/or

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965, Portland, Oregon 97208
http://www.blm.gov/or

Dear Reader,

The 2.5 million acres of Bureau of Land Management (BLM)-administered lands in western Oregon play an important role in the region's social, ecological, and economic well-being. As stewards of these lands, the BLM has a responsibility to ensure that our management is meeting our legal mandates and the needs of the local communities.

On April 24, 2015, we released a Draft Resource Management Plan/Environmental Impact Statement (Draft RMP/EIS) for the revision of the 1995 RMPs for the six BLM districts in western Oregon. During the four-month comment period that followed, we received approximately 4,500 comments from government agencies, organizations, Tribes, and members of the public. Thank you for your input; your participation has helped shaped our analysis and decision-making at every step of the planning process. If you would like to read all of the comments we received during the comment period, you can do so on our website at http://www.blm.gov/or/plans/rmpswesternoregon/comments.php.

Enclosed you will find the Proposed RMP/Final EIS. We have developed the Proposed RMP in consultation with cooperating agencies and Tribes and with consideration of the comments that we received on the Draft RMP/EIS. This document explains why we are proposing a plan revision, presents our Proposed RMP and a full spectrum of different management alternatives, and analyzes their environmental effects.

Below you will find information on the Protest Period and issuance of the Records of Decision (RODs). As always, we welcome your participation and involvement. Oregonians are in need of a lasting solution that will provide predictable outcomes and sustainable management of the BLM-administered lands in western Oregon. With your help, we are building an RMP that will provide sustainable solutions for the public lands that we are privileged to manage.

Protest Period
Pursuant to the BLM's planning regulations at 43 CFR 1610.5–2, any person who participated in the planning process for this Proposed RMP, and has an interest which is or may be adversely affected by the planning decisions, may protest approval of the planning decisions within 30 days from the date the Environmental Protection Agency publishes the Notice of Availability in the Federal Register. Protests must comply with the requirements described in the BLM's planning regulations at 43 CFR 1610.5–2. Interested parties should take care to document all relevant facts. As much as possible, specific planning documents or available planning records (e.g., meeting minutes, summaries, and correspondence) should be referenced or cited.

Emailed protests will not be accepted as valid protests unless the protesting party also provides the original letter by either regular or overnight mail postmarked by the close of the protest period. Under these conditions, the BLM will consider the emailed protest as an advance copy and will afford it full consideration. If you wish to provide the BLM with such advance notification, please direct emailed protests to the attention of the BLM protest coordinator at protest@blm.gov.

All protests, including the follow-up letter (if emailing), must be in writing and mailed to one of the following addresses:

Regular Mail:
Director (210)
Attn: Protest Coordinator
P.O. Box 71383
Washington, D.C. 20024-1383

Overnight Delivery:
Director (210)
Attn: Protest Coordinator
20 M Street SE, Room 2134LM
Washington, D.C. 20003

Before including your address, phone number, email address, or other personal identifying information in your protest, be advised that your entire protest—including your personal identifying information—may be made publicly available at any time. While you can ask us in your protest to withhold from public review your personal identifying information, we cannot guarantee that we will be able to do so.

The BLM Director will make every attempt to render a decision on each protest promptly. The protest decision will be in writing and will be sent to the protesting party by certified mail, return receipt requested. The decision of the BLM Director shall be the final decision of the Department of the Interior for the protest.

Records of Decision
Following resolution of any protests and the completion of the consistency review by the Governor of Oregon, the BLM anticipates issuing two Records of Decision/Resource Management Plans (RODs/RMPs): one ROD/RMP that would apply to the Coos Bay District, Eugene District, Salem District, and the Swiftwater Field Office of the Roseburg District; and another ROD/RMP that would apply to the Klamath Falls Field Office of the Lakeview District, the Medford District, and the South River Field Office of the Roseburg District.

The RODs/RMPs will identify the decision by the State Director on the RMP revision and the rationale for the decision. The RODs/RMPs will constitute the decision documents for the enclosed Proposed RMP/Final EIS. The RODs/RMPs will also contain the approved RMPs themselves, including the land use allocations, management objectives, and management direction. The RODs/RMPs will describe the compliance with applicable laws, the alternatives evaluated and the environmentally preferable alternative, necessary mitigations, the process for plan monitoring and evaluation, and the guidance for transition from the 1995 RMPs to the approved RMPs.

The approval of the RODs/RMPs will represent the completion of this RMP revision process. Following approval of the RODs/RMPs, the BLM will take only those management actions that are specifically provided for in the approved RMPs, or, if not specifically mentioned, actions that are clearly consistent with the goals, objectives, or management direction of the approved RMPs.

The BLM will email parties when the RODs/RMPs are available online or will mail the RODs/RMPs to parties who have requested hard copies.

For more information on the Protest Period, planning process, or public participation, you can visit our website at http://www.blm.gov/or/plans/rmpswesternoregon/index.php. Thank you for your continued interest and participation in this planning process. We look forward to continuing to work with you.

Jamie Connell
Acting State Director
Bureau of Land Management
Oregon/Washington

United States Department of the Interior
Bureau of Land Management

Proposed Resource Management Plan/Final Environmental Impact Statement for the Resource Management Plans for Western Oregon

Coos Bay, Eugene, Medford, Roseburg, and Salem Districts,
and the Klamath Falls Field Office of the Lakeview District

Cooperating agencies:

Benton County	State of Oregon
Clackamas County	Environmental Protection Agency
Columbia County	National Marine Fisheries Service
Coos County	U.S. Fish and Wildlife Service
Curry County	U.S. Forest Service
Douglas County	Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Klamath County	Confederated Tribes of Grand Ronde
Lane County	Confederated Tribes of Siletz Indians
Lincoln County	Coquille Indian Tribe
Linn County	Cow Creek Band of Umpqua Tribe of Indians
Marion County	Klamath Tribes
Multnomah County	
Polk County	
Tillamook County	
Washington County	
Yamhill County	

Abstract: This Proposed Resource Management Plan/Final Environmental Impact Statement addresses revision of the 1995 Resource Management Plans for the Coos Bay, Eugene, Medford, Roseburg, and Salem Districts, and the Klamath Falls Field Office of the Lakeview District. The purpose of this Resource Management Plan revision is to provide a sustained yield of timber, contribute to the conservation and recovery of threatened and endangered species, provide clean water in watersheds, restore fire-adapted ecosystems, provide recreation opportunities, and coordinate management of lands surrounding the Coquille Forest with the Coquille Tribe. The BLM analyzed the Proposed RMP, the No Action alternative of continued implementation of the 1995 Resource Management Plans, four action alternatives, and two sub-alternatives.

This Proposed RMP/Final EIS is open for a 30-day protest period beginning with the date the Environmental Protection Agency publishes the Notice of Availability of the Proposed RMP/Final EIS in the Federal Register. Protests must be filed with the Director of the BLM as described in the Dear Reader Letter.

For further information contact:

Sarah Levy, Public Affairs Specialist
RMPs for Western Oregon
Bureau of Land Management
P.O. Box 2965
Portland, Oregon 97208
Telephone: (503) 808-6217
Email: BLM_OR_RMPs_WesternOregon@blm.gov
Website: http://www.blm.gov/or/plans/rmpswesternoregon/

Table of Contents

Climate Change

Key Points

- Net carbon storage would increase under all alternatives and the Proposed RMP, with the largest increase under Alternative D and the least increase under Alternative C.
- Annual greenhouse gas emissions associated with BLM-administered lands would increase under all alternatives and the Proposed RMP, with the largest increase under Alternative C and the least increase under Alternative D. Annual greenhouse gas emissions associated with BLM-administered lands would remain less than 1 percent of the 2010 Statewide greenhouse gas emissions.
- Climate change provides uncertainty that reserves will function as intended and that planned timber harvest levels can be attained, with the uncertainty increasing over time.
- Active management would provide opportunities to implement climate change adaptive strategies and potentially reduce social and ecological disruptions arising from warming and drying conditions.

Summary of Notable Changes from the Draft RMP/EIS

The BLM has refined the calculations of carbon storage and greenhouse gas emissions, including the following:

- Removing the acreage in roads and water from the estimated carbon stored in soils
- Correcting the number of acres affected by wildfire
- Correcting the number of acres of expected underburning/broadcast burning
- Removing unmodeled forest as a category and replacing it with non-forest estimates
- Correcting the animal unit month values for the No Action alternative in the estimated greenhouse gas emissions

These refinements in the calculations alter the absolute values in these calculations, but do not alter the relative outcomes of the alternatives and the Proposed RMP or the overall analytical conclusions.

The BLM has corrected the values in **Table 3-13** for carbon density; the Draft RMP/EIS erroneously provided carbon density data in terms of Mg/ha instead of Mg/acre.

The BLM has added discussion and estimation of the effects of hazardous fuels treatments on net carbon storage and has expanded the discussion under Issues 1 and 2 of the cumulative effect of carbon storage and greenhouse gas emissions in the context of other actions.

Issue 1

What would be the effects of BLM forest management on long-term net carbon storage?

Summary of Analytical Methods

The BLM estimated changes in the amount of carbon stored on the landscape in vegetation and soils, and in harvested wood products. This analysis accounts for the removal of carbon through wildfire, prescribed fire, and timber harvesting and the addition of carbon through vegetation growth. As such, this analysis

estimates changes in the net amount of carbon stored under the different alternatives and the Proposed RMP.

The BLM estimated net carbon storage on BLM-administered lands in the planning area by first estimating the amount of biomass on these lands and converting that to the carbon in live trees, standing and downed dead wood, understory vegetation, litter and duff, and in the upper 1 meter (3.3 ft.) of soil, except where noted. The Planning Criteria provides detailed information on analytical assumptions, methods and techniques, and geographic and temporal scales, which is incorporated here by reference (USDI BLM 214, pp. 36–38). The volume harvested, whether part of the Harvest Land Base or reserves, drives the variation in carbon storage under the different alternatives and the Proposed RMP.

The BLM assumed the following categories to be constant across all alternatives and the Proposed RMP:

- Carbon stored in soils
- Carbon stored in non-forested lands
- Carbon loss from wildland fire

The BLM assumed no carbon is stored under roads or in water, and reduced the landbase used for net carbon storage estimation accordingly. Although there is some carbon storage under roads or in water, there is no data available to quantify this storage. Furthermore, the carbon storage would not measurably differ among the alternatives and the Proposed RMP over time, and thus would not alter the relative outcomes under the alternatives or the Proposed RMP.

Although the BLM used much of the analytical approach described in the Planning Criteria, the BLM modified the data source for aboveground carbon based on the actual outputs from the Woodstock model. Instead of using stand structure as the basis for estimating the amount of above-ground carbon, as described in the Planning Criteria, the BLM used approximate stand age in combination with the information available through the Carbon OnLine Estimator version 3.0 (COLE 3.0 2015) to estimate the amount of carbon stored in standing and downed dead wood, understory vegetation, the forest floor (litter and duff) and soil. Instead of using only two regions, the BLM filtered the COLE outputs to report carbon storage for all Federal lands in the counties in which the majority of each BLM district occurs. For example, the BLM used all Federal lands in Coos and Curry Counties as the basis for estimates for Coos Bay District. This approach allowed for estimates that were more refined and better captured the variability in carbon stored than using the two regions. The BLM used all Federal lands instead of all lands, as the data for private lands tended to be skewed towards younger age classes than are typically present on the Federal lands. Furthermore, the data for only BLM-administered lands lacked a sufficient number of the Forest Inventory and Analysis plots used by COLE to provide robust estimates. The Woodstock outputs did not specifically identify which cells were woodlands, so the BLM did not carry out this portion of the analysis as described in the Planning Criteria. Because wildfire was not included in the volume estimates for year 100, the BLM dropped that year from the analysis and added year 40, resulting in estimates for years 10, 20, 30, 40, and 50. **Appendix G** describes the carbon estimation method in further detail along with sources of uncertainty in the results.

The quantified analysis of changes in net carbon storage directly or indirectly incorporates the effects of land management actions, including timber harvest, prescribed burning, activity fuels treatments, and silvicultural treatments under the alternatives and the Proposed RMP through the vegetation modeling. Carbon affected by timber harvest has four potential fates:

- Removal from the site and processed into a wood product
- Removal from the site and burned as firewood or for energy production at a mill
- Retain on the site and burned in a fuels treatment
- Retain on the site and allowed to decay

The vegetation model accounted for the changes in net carbon storage from harvesting by reducing volume and affecting average stand age in the decade when timber harvest would occur.

The quantified analysis of changes in net carbon storage under the alternatives and the Proposed RMP does not incorporate the effects of hazardous fuels treatments[38] on net carbon storage, because it is not possible to estimate such effects on net carbon storage accurately and because the BLM assumes that the amount of hazardous fuels treatments would not vary among the alternatives and the Proposed RMP.

There is insufficient information on where and when the BLM would need to implement hazardous fuels treatments and how much biomass the treatments would remove. The BLM does not collect or store data on pre- and post-treatment biomass for the hazardous fuels treatments. Hazardous fuel treatments are highly variable in terms of acres treated and treatment methods. Hazardous fuel treatments are also highly variable in terms of treatment effects on carbon storage: not all fuels treatment methods remove the harvest residue and its carbon as a direct effect of the treatment. Material from treatments such as lop-and-scatter or mastication remains on site and decays naturally. Biomass removal, primarily for personal use firewood, currently accounts for only 4 percent of the acres treated under the hazardous fuels treatments, with an unknown amount of biomass affected. While biomass removal for commercial energy production may occur or increase in the future, currently low product value and high transportation costs means very few facilities have been built or planned within or near the planning area that would use forest residues as a fuel source, and none have been built that use forest residues as a primary fuel source. Since BLM cannot parameterize the stand conditions where the hazardous fuels treatments would occur, the BLM could not include hazardous fuels treatments in the vegetation model.

The primary effect of hazardous fuels treatments on net carbon storage comes from prescribed burning of piled vegetation, underburns, or broadcast burns. Factors influencing the amount of carbon removed by burning include pile size, pile shape, number of piles per acre, and amount of fuel both available and combusted through underburns or broadcast burns. With an estimated 173,300 acres of pile burning, underburns, and broadcast burning per decade, the additional reduction in net carbon storage from the hazardous fuels program would be less than 1teragram[39] of carbon (Tg C), or less than 1 percent, per decade. Because of the insufficient information about future hazardous fuels treatments, the high variability in the implementation of hazardous fuels treatments, and the high variability in the effects of hazardous fuels treatments on carbon storage, this estimation of the effects of hazardous fuels treatments under the alternatives and the Proposed RMP at this scale of analysis is of very low accuracy. The BLM includes this estimation here to give context to the magnitude of the potential effect of hazardous fuels treatments on net carbon storage.

It is possible that hazardous fuels treatments (and other land management actions) could indirectly reduce the loss of new carbon storage resulting from wildfire by reducing the severity and extent of future wildfires. However, it is not possible to quantify any change in future wildfire effects resulting from hazardous fuels treatments (see the Fire and Fuels section in this chapter).

[38] Hazardous fuel treatments are non-commercial treatments that are designed to reduce existing, natural fuel accumulations. In contrast, activity fuel treatments are designed to reduce fuel accumulations created by management actions such as timber harvest (see the Fire and Fuels section in this chapter). The BLM assumed in this analysis that implementation of hazardous fuels treatments would not vary by alternative and the Proposed RMP. However, activity fuel treatments would vary by alternative and the Proposed RMP, because the BLM would implement activity fuel treatments in response to fuels created by differing management actions.

[39] Scientific literature on carbon storage at this scale of analysis reports carbon amounts in metric tons, which are equal to approximately 2,205 pounds. One million metric tons equals one teragram.

In addition to comparing the alternatives and the Proposed RMP, the BLM also considered two reference analyses as a means of providing additional context for the alternatives and the Proposed RMP: the No Timber Harvest Reference Analysis without wildfire (providing an estimate of potential carbon storage resulting from the vegetation growth) and the No Timber Harvest reference analysis with wildfire. Comparing these two reference analyses allowed the BLM to estimate the effect of this natural disturbance alone and then in conjunction with harvesting in the alternatives and the Proposed RMP.

The quantified analysis of changes in net carbon storage under the alternatives and the Proposed RMP does not incorporate the potential effects on carbon storage from changing climate conditions. The vegetation modeling did not incorporate projections of climate change into the simulation of the growth of stands through time (see the Vegetation Modeling section in this chapter). Climate change would alter the absolute estimates of net carbon storage over time, but would not alter the relative outcomes under the alternatives and the Proposed RMP. Based on recent research, climate change would likely result in smaller increases in future carbon storage in the decision area than estimated in this analysis, though differences may not be apparent within the time frame of this analysis. Using a different analysis method than the carbon analysis in this Proposed RMP/EIS that accounted for changing climate, Diaz *et al.* (2015) also found that net carbon storage in trees would increase on BLM-administered lands within the planning area until mid-century and then level off under lower emissions scenarios and decline under other emissions scenario. Creutzburg *et al.* (2016) found that climate change would slow expected carbon accumulation rates in the northern Coast Range by about 8 percent relative to a static climate, largely between mid-century and the end of the century, but that total carbon would continue to increase. Rogers *et al.* (2015), using three different climate models, found that in western Oregon and Washington, carbon storage would increase slightly under two of the models by the end of the century but decline substantially under the third model.

Future carbon storage on BLM-administered lands could differ from these estimates if the use of biomass for energy increases substantially. Using harvest-generated residues for bioenergy is a common proposition to reduce emissions from burning fossil fuels and both greenhouse gas and particulate emissions associated with prescribed burning to remove such residues. Although such changes in biomass utilization are possible, they are not reasonably foreseeable at this time (see the Sustainable Energy section in this chapter). A recent study in the Panther Creek watershed in northwestern Oregon indicates that if both private forests and BLM-administered lands were to 'capture' such residues for bioenergy production, net carbon storage would decline by only 2–3 percent relative to conventional harvest methods (Creutzburg *et al.* 2016). Rotation length and the age at which no harvesting would occur on BLM-administered lands had the main effect on carbon storage in the watershed, which includes a mix of BLM-administered and private lands. This same study also found that longer rotations and less intensive management on Federal and non-corporate private lands could counterbalance shorter rotations and more intensive management on private lands (Creutzburg *et al.* 2016).

There are multiple sources of uncertainty in estimating the amount of carbon stored on the BLM-administered lands within the planning area, which are discussed in more detail in **Appendix G**. Although it is not possible to quantify all of the sources of error, the potential error in the estimate for any one alternative and the Proposed RMP likely exceeds the amount of variance among the alternatives and the Proposed RMP. The U.S. Forest Service estimated standard errors ranging from 20 percent to slightly over 50 percent, averaging around 33 percent, for their lands in western Oregon (USDA FS 2015). The BLM standard errors are likely similar, albeit on the higher end of this range, given the estimation methods used.

Affected Environment

The BLM-administered lands within the planning area currently store an estimated 360 Tg C (**Table 3-13**). In the 2008 FEIS, BLM estimated current carbon storage at 427 Tg, using a similar but more

simplified approach that relied primarily on regional averages (USDI BLM 2008, pp. Appendices – 28-29). The type of data available in 2008 for estimating carbon storage did not allow the more detailed approach used in this analysis.

Table 3-13. Estimated current total carbon stored in vegetation and soil and carbon density

District/ Field Office	Acres	Total Carbon (Tg C)	Carbon Density (Mg C/Acre)
Coos Bay	313,945	59	190
Eugene	300,736	60	198
Klamath Falls	210,386	9	41
Medford	782,524	93	119
Roseburg	408,680	63	155
Salem	385,806	76	196
Totals	**2,402,076**	**360**	**-**

The Medford District currently stores the most carbon, with an estimated 93 Tg C, largely due to the size of the district. The Klamath Falls Field Office stores the least, approximately 9 Tg C, largely due to the high proportion of non-forest plant communities within the Field Office boundaries and the small size of the Field Office. Approximately 6 Tg C is currently stored in products made from wood harvested from BLM-administered lands that are either still in use or are located in sanitary landfills where decay rates are minimal (Earles *et al.* 2012). In the 2008 FEIS, the BLM estimated carbon storage in landfills and wood products was 11 Tg C using an approach based on the assumed proportion of pulpwood to saw logs and estimates of the cumulative emissions of carbon over time by each type of product (USDI BLM 2008, pp. Appendices – 30). In this analysis, the BLM estimated carbon storage in landfills and wood products using a decay function derived from Earles *et al.* (2012) that consolidated the same type of information used in 2008 with estimates from the Oregon Department of Forestry on the annual board foot volumes harvested from BLM-administered lands within the planning area from 1965 through 2012. The combination of carbon stored on the districts and in wood products brings the total estimated carbon storage currently associated with BLM–administered lands in the planning area to 366 Tg C.

Carbon density, the amount of carbon per acre, provides a comparable measure between the districts that reflects carbon storage capability and general productivity. The Coos Bay, Eugene, and Salem Districts are moderate in size but have a high carbon density (**Table 3-13**). The Medford District has the largest acreage of BLM-administered lands of the administrative units in the decision area, and has the largest amount of total carbon storage, but has the second lowest estimated carbon density. The Klamath Falls Field Office has the smallest acreage of BLM-administered lands of the administrative units in the decision area and has the lowest carbon density.

Environmental Consequences

Timber harvest volume removed is the primary driver of differences across the alternatives and the Proposed RMP in net carbon storage on BLM-administered lands in the planning area, although a portion of the material harvested remains stored for up to 150 years in the form of wood products in use or in sanitary landfills (Earles *et al.* 2012). Comparing the No Timber Harvest reference analysis without fire to the No Timber Harvest Reference Analysis with fire indicates that wildfire reduces estimated net carbon storage by 0.4–0.7 percent across the planning area through 2063, varying by decade. For the Coos Bay, Eugene, and Salem Districts, and the Klamath Falls Field Office, the estimated reduction would be generally less than 0.3 percent of the net carbon stored on those Districts. On the Roseburg District, the reduction would be highly variable, ranging from as little as 0.12 percent to as high as nearly 3 percent.

The expected reduction on the Medford District would be less variable, ranging from 1 to 2 percent, given that approximately 82.5 percent of the acres burned are predicted to occur on that district.

All alternatives and the Proposed RMP, including the No Action alternative, would increase net carbon storage over time relative to the current condition (**Figure 3-13** and **Figure 3-14**). Differences among the alternatives and the Proposed RMP, and in comparison to the No Timber Harvest Reference Analysis with fire, would be minor until around 2033, and afterwards would become increasing apparent. Although Alternative D has the second largest Harvest Land Base of the alternatives and the Proposed RMP, the volume removed per acre would be low due to the overall approach to timber management (see the Forest Management section in this chapter). Alternative D would store the most net carbon, followed, in order, by Alternative A, the Proposed RMP, Alternative B, No Action, and Alternative C. The differences in net storage among the Proposed RMP, Alternative A, and Alternative B would be quite small. Carbon stored in wood products would range from an estimated 5 to 10 Tg, depending on alternative and the Proposed RMP and decade.

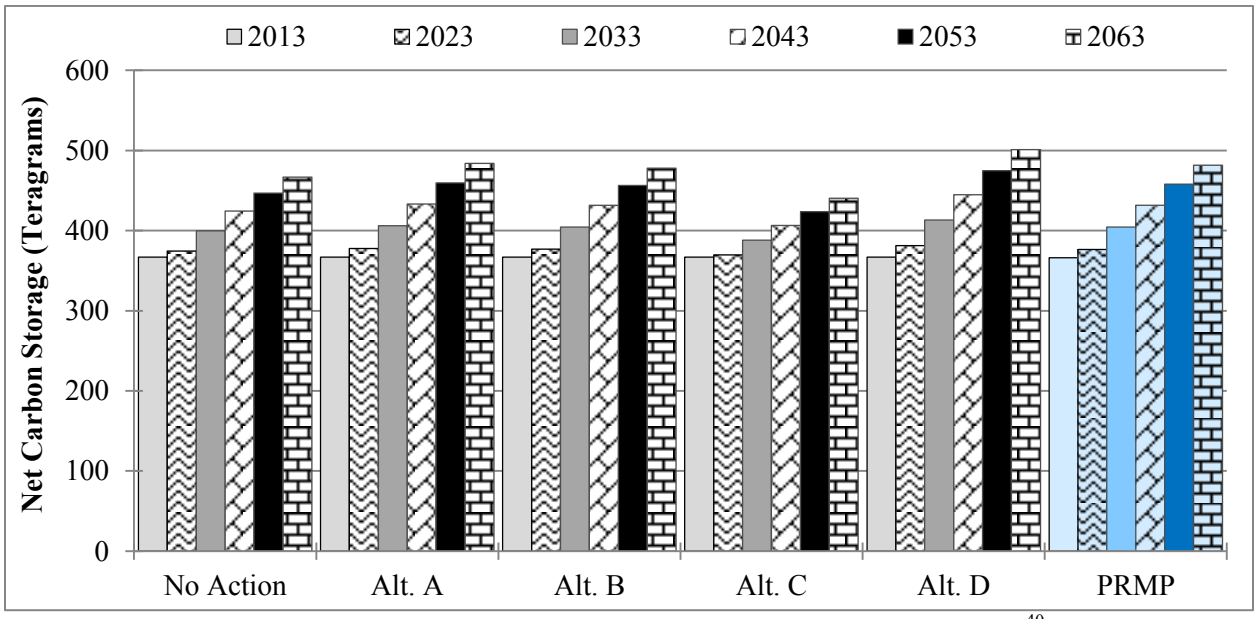

Figure 3-13. Estimated carbon storage over time by alternative and the Proposed RMP[40]

[40] The 2013 value for the Proposed RMP is slightly less than the alternatives, because the BLM has updated current vegetation baseline information to incorporate the effects of the 2013 and 2014 fire seasons (see the Analytical Methodologies and Assumptions section of this chapter).

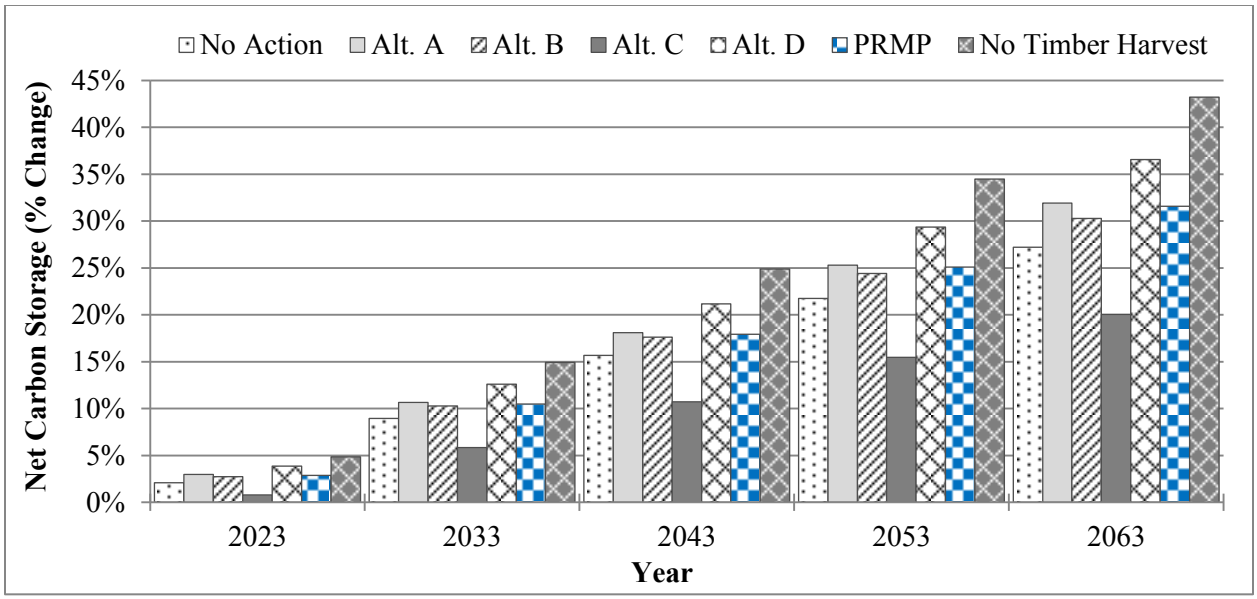

Figure 3-14. Change in carbon storage relative to the estimated total storage as of 2013

All alternatives and the Proposed RMP would increase net carbon storage, but not as much as under the No Timber Harvest reference analysis with wildfire (**Figure 3-15**). The difference in the increase in net carbon storage occurs as harvesting removes carbon and shifts stand characteristics, such as mean diameters and heights, in more of the landscape to smaller trees and younger age classes that store less carbon. Since Alternative C would harvest the most volume over time and would have the highest percentage of the landscape in younger age classes dominated by smaller trees, relative to the No Timber Harvest reference analysis, it would have the lowest increases in net carbon storage. After 2033, the Proposed RMP would store slightly less carbon than Alternative A, and slightly more carbon than Alternative B.

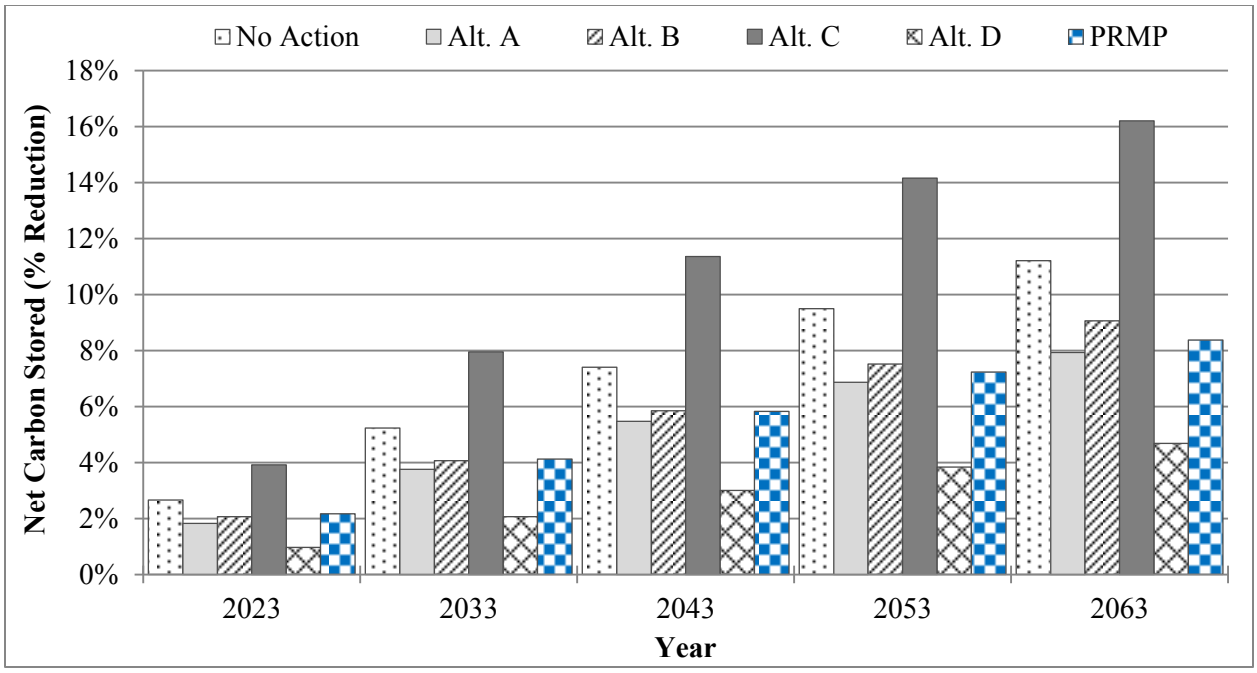

Figure 3-15. Percent reduction in aboveground carbon storage from timber harvest relative to projected carbon storage in the No Timber Harvest reference analysis with wildfire

Effect of Net Carbon Storage on BLM-administered Lands in the Context of Other Lands

Placing carbon storage on BLM-administered lands in context of other lands in the planning area is difficult due to the nature of the data available, which is variable in extent of geographic coverage, in assessment dates, and in the carbon pools assessed. The most recent published statewide assessment covered live and dead trees and downed wood measured between 2001 and 2005, but does not include all carbon pools (Donnegan *et al*. 2008). In that assessment, all the forests in Oregon, including juniper woodlands, store an estimated 1,215 Tg C in live and dead trees and downed logs and large branches. That assessment concluded that U.S. Forest Service lands, privately owned lands, and the BLM-administered lands store 56.7, 23.3, and 11.8 percent of the statewide total, respectively. The estimated statewide total for all BLM-administered lands (which includes BLM-administered lands outside of the decision area) of 144 Tg C as of 2005 is considerably less than the BLM estimated in either the 2008 FEIS analysis or in this analysis for western Oregon. Other Federal lands, State and local government lands, Tribal lands, and other private lands stored the remaining 8.4 percent, with slightly over half of that amount on State forests.

The U.S. Forest Service has also estimated the amount of carbon stored in all pools (live and dead trees, downed wood, litter and duff, and the top meter of soil) for all U.S. Forest Service lands in 2013, providing a basis of comparison with BLM-administered lands in the decision area. The BLM obtained the data for the Fremont, Mt. Hood, Rogue River-Siskiyou, Siuslaw, Umpqua, and Willamette National Forests to compare with the BLM estimates above. The BLM-administered lands (which constitute 34.8 percent of the acreage of U.S. Forest Service lands) stored approximately 39.4 percent of the amount of carbon stored on U.S. Forest Service lands;[41] that is, carbon is stored on BLM-administered lands at 113.3 percent of the density as on U.S. Forest Service lands (**Table 3-14**).

[41] This comparison does not account for the effects of wildland fires in 2013 and 2014, which affected both BLM-administered lands and U.S. Forest Service lands.

Table 3-14. Estimated carbon storage and carbon density for the major land ownerships in western Oregon

Land Owner/ Manager	Assessment Period	Total Carbon* (Tg C)	Acres	Carbon Density (Mg C/Acre)
BLM	2013	361	2,402,076	150.4
U.S. Forest Service	2013	916	6,900,020	132.8
State of Oregon	2001–2010	96	789,610	122.0
Private Landowners	2001–2010	559	6,614,392	34.2

***** Does not include carbon stored in wood products still in use or in landfills

Based on data from 2001 through 2010, forests managed by the state of Oregon in western Oregon have a slightly lower carbon density than the U.S. Forest Service lands (Gray 2015, personal communication; **Table 3-14**). This lower carbon density may be due to the amount of area in younger forests, such as the Tillamook State Forest, even though most of the State forestlands are located in the highly productive Coast Range or at similar elevations as the BLM-administered lands in the Cascade Range. Although private forestlands in western Oregon store a large amount of carbon and encompass an area similar in size as U.S. Forest Service lands, they have the lowest carbon density (Gray 2015, personal communication, **Table 3-14**), likely due to the predominance of intensively managed forests, which the owners typically manage on a 40- to 60-year rotation.

Carbon storage increased on the western Oregon U.S. Forest Service lands by approximately 1.73 Tg/yr between 1990 and 2013, despite the decreases on the Siskiyou National Forest and the apparent stabilization on the Rogue River National Forest (USDA FS 2015). Gonzalez *et al.* (2015) reported that forest ecosystems in California lost carbon between 2001 and 2010, which they attributed principally to recent large wildfires in northern California and the Sierra Nevada Mountains. Southwest Oregon may be experiencing a similar effect given the high similarity in forest types with northern California and recent increases in area burned. The BLM does not know whether the BLM-administered lands in southwest Oregon (primarily Medford and Roseburg Districts) are experiencing the same loss or stagnation in carbon storage given the lack of long-term annual carbon data.

Carbon storage on BLM-administered lands in the decision area likely increased by a similar amount given the similarity in management between the BLM and the U.S. Forest Service over that period. The BLM estimated net carbon storage would increase by a low of 1.5 Tg/yr under Alternative C to a high of 2.7 Tg/yr under Alternative D. Under the Proposed RMP, carbon sequestration would average 2.3 Tg/yr over the next 50 years. However, these estimates do not account for potential sources of mortality other than fire and potential increases in wildfire occurrence, size, or severity that might reduce that sequestration rate. The expected increase in net carbon storage as well as other forest management actions (see the Forest Management section in this chapter) under all alternatives and the Proposed RMP supports the Oregon interim strategy for reducing greenhouse gas emissions, although to what degree is not known since the State has not established specific carbon storage goals (OGWC 2010, 2013).

Issue 2

What would be the BLM's expected contribution to greenhouse gas emissions from vegetation management activities such as timber management and prescribed burning?

Summary of Analytical Methods

In this issue, the BLM estimated the gross greenhouse gas emissions from timber harvest, prescribed burning, wildfires and livestock grazing. These estimates are the direct emissions for all greenhouse gases emitted through natural processes (carbon dioxide, methane, and nitrous oxide). The carbon analysis under Issue 1 accounts for the carbon losses from fire and timber harvest by evaluating changes in net carbon storage. This analysis includes all greenhouse gases, including those that lack carbon (nitrous oxide), and all relevant sources of emissions, including those that do not directly affect net carbon storage. Because methane and nitrous oxide have higher global warming potential than carbon dioxide, the BLM followed global and national standards by reporting greenhouse gas emissions as carbon dioxide equivalents (CO_2e). One methane molecule effectively equals 25 carbon dioxide molecules and one nitrous oxide molecule effectively equals 298 carbon dioxide molecules.

Greenhouse gas emissions from BLM management activities that are most likely to be substantial and to vary among alternatives and the Proposed RMP are timber harvesting, grazing, and prescribed burning. A wide variety of BLM activities produce greenhouse gases, but the absence of reliable data limits the BLM's ability to estimate emissions. For example, BLM-authorized mining operations are a source of greenhouse gases, but there is no data on which to base estimates of emissions from this sector, particularly since mining operations within the decision area currently involve salable and locatable minerals only (USDI BLM 2013, pp. 57–58). The BLM has no information on the type of equipment used for mining or for how long (see also the Minerals section in this chapter). The BLM could not locate any general information on greenhouse emissions from mining other than for coal; coal mining does not occur within the planning area.

The BLM estimated greenhouse gas emissions for each alternative and the Proposed RMP, expressed in the form of carbon dioxide equivalent (CO_2e), using projected timber harvest, permitted levels of grazing, and prescribed burning. The Planning Criteria provides more detailed information on analytical assumptions, methods and techniques, and geographic and temporal scales, which is incorporated here by reference (USDI BLM 2014, p. 38). The BLM changed the method for this analysis from what was described in the Planning Criteria by providing a greenhouse gas emission for year 40 and by not estimating emissions past year 50, since that was the last year for which the BLM modeled wildfire.

The BLM estimated emissions from timber harvest by converting the estimates of board feet harvested to cubic feet and applying the emissions factor listed in the Planning Criteria (USDI BLM 2014, p. 38). The BLM estimated methane emissions from public lands grazing using the emission factor described by the Intergovernmental Panel on Climate Change (Eggleston *et al*. 2006). Instead of the emission factor listed in the Planning Criteria for prescribed fires, the BLM used estimated emissions from Consume 4.2 for carbon dioxide and methane and the emission factor provided by the Environmental Protection Agency for burning wood and wood products as a stationary source for nitrous oxide (EPA 2014a, Table 1) as the BLM believes these emission estimation methods are more accurate than the single emission factor initially proposed in the Planning Criteria. To provide context for the emissions from harvesting and prescribed burning, the BLM also estimated greenhouse gas emissions from wildfires. The BLM used a combination of wildfire records, fuelbeds from the Fuels Characteristic Class System (FCCS) version 3.0, and emissions estimates from Consume 4.2 to estimate emissions from wildfires. **Appendix G** details the estimation methods and associated uncertainties.

This analysis may overestimate greenhouse gas emissions from both prescribed fire and wildfire. At least some of the carbon produced by wildland fires is deposited as pyrogenic organic matter, also known as charcoal, biochar, and black carbon, instead of being emitted into the atmosphere (Lehmann *et al*. 2006, Sohi *et al*. 2010, Santín *et al.* 2015). The amount of biochar produced depends on fire intensity (Nocentini *et al*. 2010, Sohi *et al*. 2010, Santín *et al*. 2012) and lignin content (Lehmann *et al*. 2006, Makoto *et al*.

2011). Biochar produced by wildland fire can persist in soils for several hundred to several thousand years (e.g., Spokas 2010, Sohi *et al*. 2010, Criscuoli *et al*. 2014, Santín *et al*. 2015, and Wang *et al*. in press), providing storage instead of emission. Factors governing the durability of biochar in the soil include soil texture (Pingree *et al*. 2012 and references therein), particle size (Nocentini *et al*. 2010), the oxygen to carbon ratio in the particles (Spokas 2010), and fire frequency (Nocentini *et al*. 2010, Pingree *et al*. 2012). Estimates of the amount of biochar produced vary widely, however, ranging from 1 to 28 percent of the above ground biomass (Lehmann *et al*. 2006, Sohi *et al*. 2010, Pingree *et al*. 2012, Santín *et al*. 2015), making any attempt to estimate this potential reduction in greenhouse gas emissions highly uncertain.

Background

Globally, atmospheric carbon dioxide (CO_2) concentrations have increased from an estimated 277 ppm (parts per million) before 1750 to 395.31 ± 0.1 ppm in 2013, the highest level in the last 800,000 years according to the Global Carbon Project (2015). Preliminary estimates indicate global atmospheric CO_2 concentrations reached 397.15 ppm in 2014. According to CO_2Earth.org (2015), monthly atmospheric CO_2 concentrations surpassed the 400 ppm benchmark during April through June of 2014 and February through July of 2015 at the Mauna Loa Observatory. Carbon dioxide is the primary greenhouse gas, comprising over 80 percent of total emissions globally, as well as in both the U.S. and Oregon. Fossil fuel combustion is the primary source of CO_2 (McConnaha *et al*. 2013, Le Quéré *et al*. 2014, 2015; EPA 2014b, 2015). United States emissions of greenhouse gasses (6,673 Tg CO_2e) were 14 percent of global emissions (~ 47,664 Tg CO_2e) in 2013 (Le Quéré *et al*. 2015; EPA 2015). In 2010, the latest year in which data are available, Oregon's emissions were about 1 percent of the U.S. emissions (McConnaha *et al*. 2013, EPA 2014b). Globally, ocean and land greenhouse gas sinks removed about 50 percent of that emitted in 2013 (Le Quéré *et al*. 2015). Land sinks in the U.S. effectively reduced total greenhouse gas emissions by 13.2 percent nationally in 2013, with forests and wood products accounting for about 11.5 percent (EPA 2015). The forests of western Oregon sequester more carbon per acre than the national average (Joyce *et al*. 2014, Figure 7.5).

Several scientific studies have concluded that greenhouse gas emissions from human activities are driving relatively rapid climate change (IPCC 2013 and references therein). Under the current state of the science, however, the BLM cannot identify the impacts of greenhouse gas emissions from any one project or program, or from its activities in western Oregon on global, national, or even local climate. In 2004, the state of Oregon released its statewide strategy for greenhouse gas reductions. Oregon's goal is to reduce statewide greenhouse gas emissions to at least 75 percent below 1990 levels by 2050, or to approximately 15 Tg CO_2e (ODOE 2004). To achieve this goal the State strategy calls for increased energy conservation, increased energy efficiency among natural gas and oil users, increased efficiency in transit and alternatives to driving cars and trucks, primarily in urban areas along the I-5 corridor, increased use of products that use less energy to produce and are designed for reuse or easy recycling, replacing fossil fuels with alternative energy sources, and increasing carbon capture and storage in forests and farms (ODOE 2014). Of these elements, BLM-administered lands would support this strategy through increased carbon capture and storage in forests.

Affected Environment

Total estimated greenhouse gas emissions from timber harvest, grazing, and prescribed fire on BLM-administered lands within the planning area averaged 122,398 Mg CO_2e/yr over the past 19 years (1995–2013) (**Figure 3-16**), or about 0.2 percent of Oregon's in-boundary[42] 2010 emissions (McConnaha *et al.* 2013). Prescribed fires emitted about 90 percent of the BLM management-related greenhouse gases. In contrast, average emissions from wildfires that originated on BLM-administered lands were

[42] In-boundary emissions are those that occur within Oregon's borders and emissions associated with electricity use within Oregon.

approximately 69,636 Mg CO_2e/yr or about 36 percent of all greenhouse gas emissions originating on BLM-administered lands within the planning area over the past 19 years (**Figure 3-16**). Prescribed fires emitted more greenhouse gases, on average, than wildfires over this time period. Emissions for any one year varied widely, largely depending on the amount of prescribed fire and wildfire, although emissions from prescribed fires varied much less than those from wildfires.

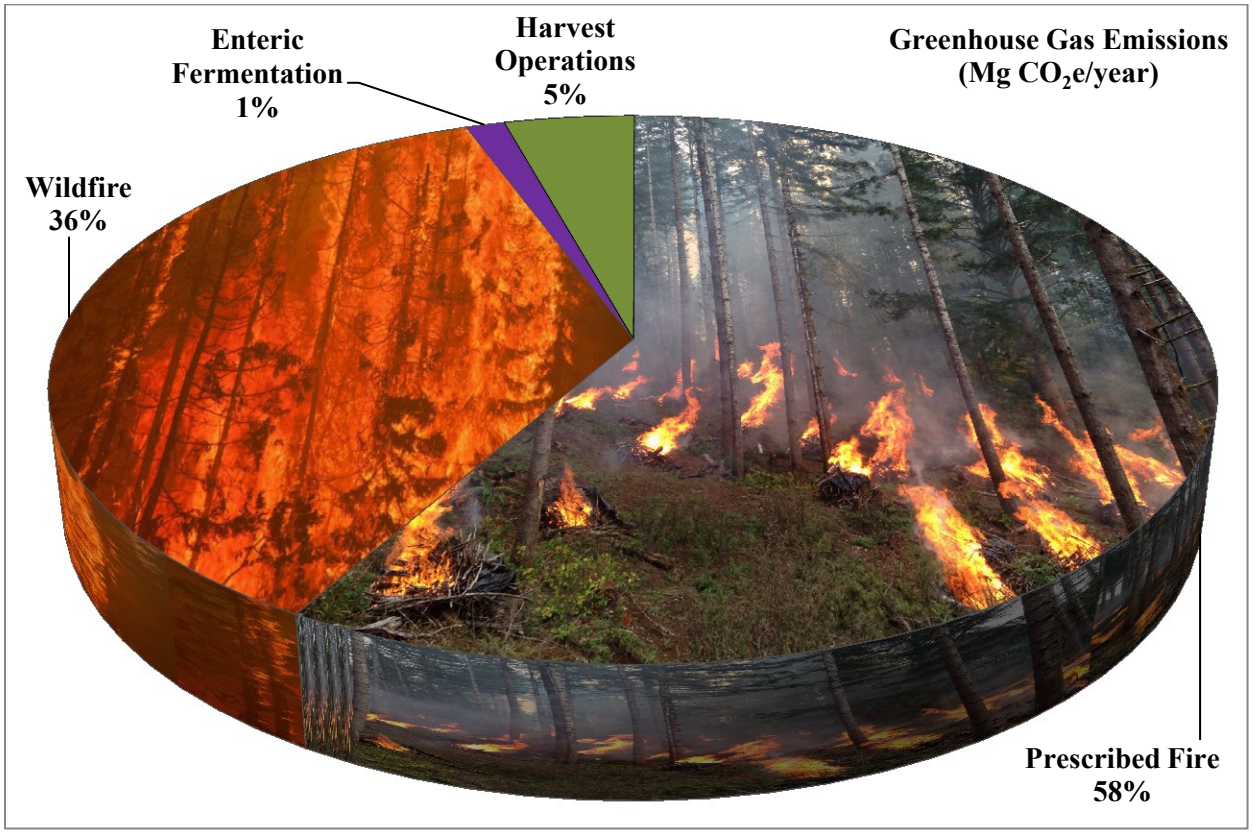

Figure 3-16. Proportion of estimated greenhouse gas emissions from livestock grazing (enteric fermentation), timber harvest operations, prescribed fires, and wildfires on BLM-administered lands within the planning area

The estimate of current greenhouse gas emissions for BLM-administered lands within the planning area represents the actual level of activity. This is in contrast to the analysis of the No Action alternative in the following section, which projects future implementation of 1995 RMPs as written. Actual harvest levels and grazing have been below what the 1995 RMPs anticipated (USDI BLM 2013). Therefore, prescribed burning of activity fuels created by harvesting activities is generally less than what was anticipated in 1995, but prescribed burning of so-called natural fuels, or hazardous fuels, under the National Fire Plan (USDA FS and USDI BLM 2000) has partially compensated for the reduction in activity fuels burning. The National Fire Plan increased funding for hazardous fuels reduction beginning in 2001.

The available data do not indicate how much of the prescribed burning was activity fuel reduction and how much was hazardous fuels reduction. The BLM explicitly designs the hazardous fuels reduction program to reduce potential fire behavior and effects and, hence, greenhouse gas emissions from wildfires. While the BLM does not design silvicultural treatments to reduce hazardous fuels, many treatments serve to do that as a secondary benefit of enhancing tree growth on the remaining trees (see also the Fire and Fuels section for additional analysis and references). Many studies also demonstrate that

reducing the fuels created by any forest vegetation treatment, regardless of the primary purpose of the treatment, is essential to reducing potential wildfire behavior and effects and resulting greenhouse gas emissions (e.g., Pritchard *et al.* 2010, Lyons-Tinsley and Peterson 2012, Safford *et al.* 2012, and Shive *et al.* 2013).

The BLM is a relatively small emitter of greenhouse gases from harvest operations and prescribed fire within the planning area (**Figure 3-17**, the Other Federal category is largely BLM). Management on private forests and on U.S. Forest Service lands each result in greater emissions. In large part, these differences reflect the differences in land base and, in the case of private forests, management intensity. Prescribed fire emissions in private forests are largely due to clean up of harvest-generated residue (activity fuels), whereas a portion of the prescribed fire emissions from U.S. Forest Service lands and BLM-administered lands arises from the hazardous fuels reduction program in both agencies under the National Fire Plan.

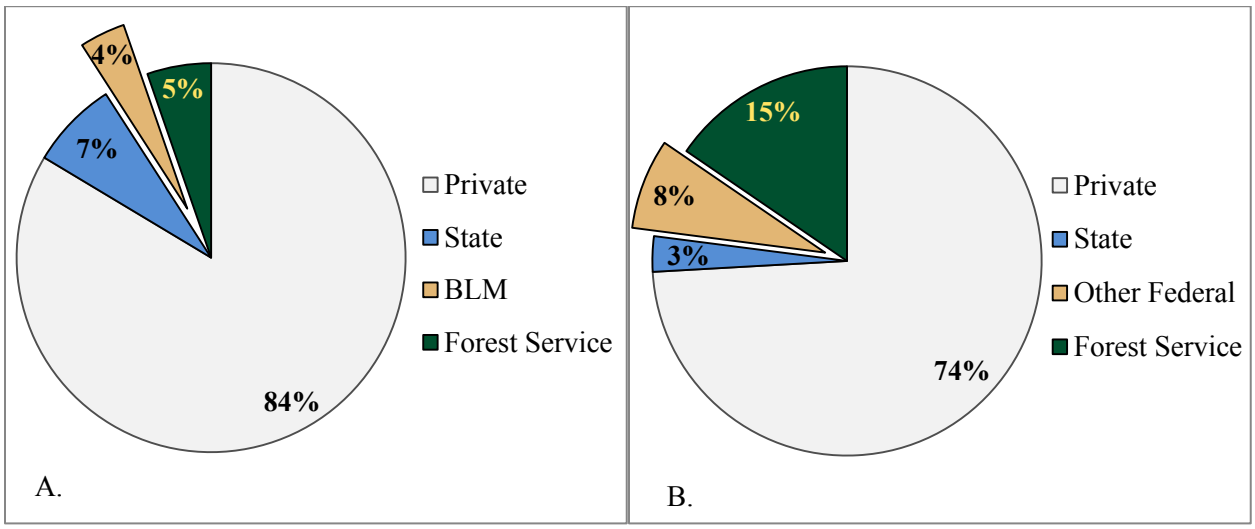

Figure 3-17. Proportion of estimated greenhouse gas emissions from (a) timber harvest and (b) prescribed burning by different entities

Trends in emissions are more difficult to ascertain. Emissions from grazing on BLM-administered lands within the planning area have very slightly declined since 1995, as more allotments became vacant and the amount of active use declined. No trend is evident in wildfire emissions due to very high interannual variability in the acres burned on BLM-administered lands over the period of record (1980–2013).

Although interannual variability in emissions from harvest operations and prescribed burning is also high, some trends are apparent. Harvesting on private forests reflects current economic conditions, particularly in the housing market. During the recent housing boom, harvesting and the resulting greenhouse gas emissions from private land harvesting increased from the late 1990s until 2007. Between 2007 and 2009, emissions declined sharply, reflecting the economic downturn, which had a substantial impact on housing demand and lumber. This same effect on greenhouse gas emissions was also apparent nationally (EPA 2014b). Since 2009, harvesting levels and associated emissions have recovered to pre-recession levels. In contrast, harvesting levels and resulting emissions have been slowly increasing on both BLM-administered and U.S. Forest Service lands since 2001, with a slightly higher trend on the U.S. Forest Service lands.

The trends in emissions from prescribed burning do not track the trends in emissions from harvesting operations. On private forests, emissions from prescribed burning have fallen since about 2006, even when harvest levels have risen. Whether the continued fall represents a lag between time of harvest and time of site preparation, a reduction in activity fuels due to higher utilization, or a shift in how the land managers handled activity fuels is unknown. Fluctuations in emissions from prescribed burning on BLM-administered lands and the U.S. Forest Service lands within the planning area may reflect a combination of higher utilization and fluctuations in the hazardous fuels program. Since 2009, prescribed fire emissions from U.S. Forest Service lands have risen slowly, while emissions have fallen slowly on BLM-administered lands.

Environmental Consequences

As with particulate emissions (see the Air Quality section of this chapter), the amount of activity fuels prescribed burning is the primary factor driving the differences between alternatives and the Proposed RMP and over time. Greenhouse gas emissions from BLM activities would increase substantially relative to the estimate of current actual emissions under all alternatives and the Proposed RMP, with the exception of Alternative D (**Figure 3-18** and **Figure 3-19**). This increase would be largely due to the amount of prescribed burning that would occur in conjunction with harvesting. Alternative C would result in the largest increases. However, even the highest projected emissions under Alternative C would remain less than 1 percent of Oregon's 2010 in-boundary greenhouse gas emissions and approximately 0.0008 percent of total U.S. greenhouse gas emissions in 2012 (EPA 2014b, Figure ES-1). Greenhouse gas emissions under Alternative B would be the second highest of all alternatives and the Proposed RMP. The Proposed RMP and Alternative A would result in similar emissions, lower than Alternative B and the No Action alternative. Alternative D would result in the lowest emissions of all alternatives.

The BLM has considered measures that would reduce or avoid increases in greenhouse gas emissions above current levels. The current implementation of the timber management program is not consistent with the 1995 RMPs as written (see the Purpose and Need for Action section in Chapter 1; current implementation has been predominately thinning, and the current practices are not sustainable at the declared timber harvest levels (see the Alternatives Considered but not Analyzed in Detail section of Chapter 2). The current level of greenhouse gas emissions is substantially lower than the emissions that this analysis shows would result from implementation of the No Action alternative. The level of sustained-yield timber production and associated prescribed burning generally would reflect the level of greenhouse gas emissions. Any alternative that would provide a sustained yield of timber and restore fire-adapted ecosystems would necessarily result in increases in greenhouse gas emissions above current levels. The alternatives and the Proposed RMP would result in varying amounts of increase in greenhouse gas emissions above current levels. However, it would not be possible to avoid increases in greenhouse gas emissions above current levels and meet the purposes of the action.

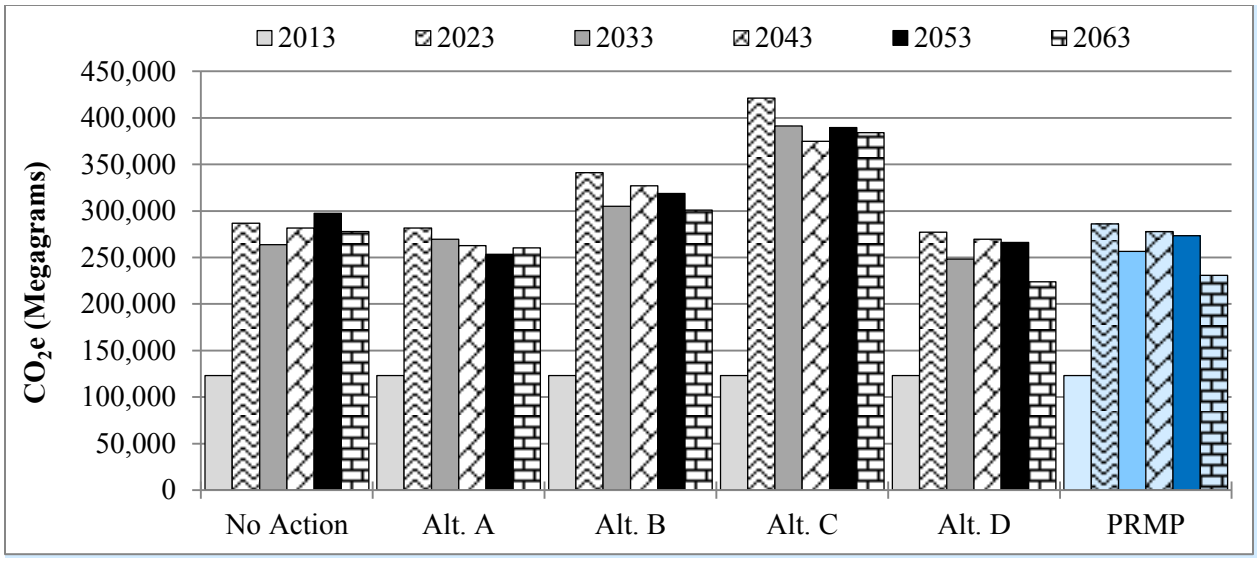

Figure 3-18. Estimated average annual greenhouse gas emissions from the combination of timber harvest, grazing, and prescribed fire

Note: Variation in activity fuels prescribed fire levels causes most of the fluctuation in expected emissions between decades.

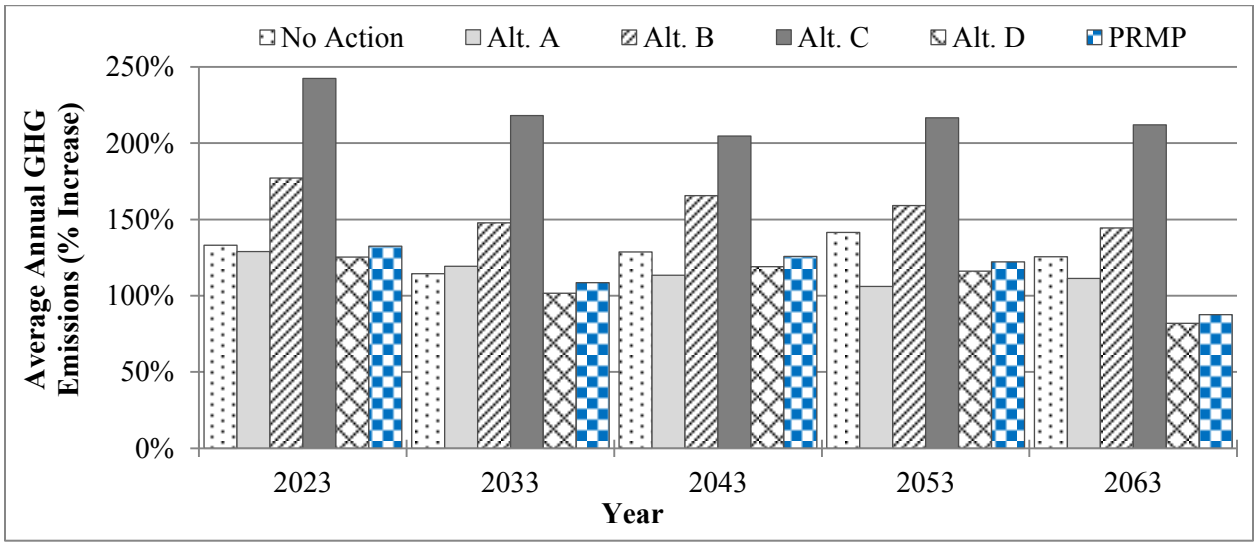

Figure 3-19. Projected increases in average annual greenhouse gas emissions from timber harvest, grazing, and prescribed burning relative to average annual emissions as of 2013

Effect of Greenhouse Gas Emissions from BLM-administered Lands in the Context of Other Sources

Placing BLM's greenhouse gas emissions in a statewide or national context is difficult for the same reasons as discussed above for carbon storage. In addition, greenhouse gas emissions are rarely estimated for the forestry subsector alone. The EPA groups emissions from forestry operations into the agricultural sector. In 2013, national emissions from the agricultural sector were 586.8 Tg CO_2e, or 8.8 percent of total U.S. emissions. Land use and forestry emissions accounted for 1.9 percent of agricultural emissions,

or 10.9 Tg CO_2e (EPA 2015). Data for the state of Oregon does not include an estimate of emissions from land use and forestry.

The 2013 estimate for BLM's greenhouse gas emissions are 0.2 percent of the U.S. 2013 estimate for the agriculture sector. The BLM greenhouse gas emissions through 2063 would range from 0.3 to 0.7 percent of the U.S. 2013 estimate for the agricultural sector. Greenhouse gas emissions for each alternative and the Proposed RMP would fluctuate over the assessment period, depending on the extent of timber harvest and subsequent prescribed burning. Greenhouse gas emissions from timber harvest operations would be a higher proportion of BLM total emissions than they are in the national emissions, ranging from as low as 4.2–5.4 percent under Alternative D to as high as 8.6–9.4 percent under Alternative C. Under the Proposed RMP, harvest emissions would account for between 5.2–6.4 percent of BLM's expected total greenhouse gas emissions. The BLM emissions differ from the national emissions for the agricultural sector in that livestock and crop cultivation produced 90 percent of the national emissions whereas prescribed burning is expected to produce 90–96 percent of the emissions from BLM, depending on the alternative and decade.

The BLM also compared how the relative proportions of greenhouse gas emissions would change for harvesting and prescribed fire assuming no change in the emissions from private forest owners, the State of Oregon, and other Federal agencies, using average annual estimates over the entire analysis period (50 years). The BLM's proportion of annual harvesting-related greenhouse gas emissions would increase from about 4 percent of the western Oregon estimate to a low of 5 percent per year under Alternative D and a high of 14 percent per year under Alternative C. The Proposed RMP annual harvesting greenhouse gas emissions would approximately double to an estimated 8 percent of western Oregon harvesting emissions, or 0.02 Tg CO_2e per year on average. The BLM's proportion of greenhouse gas emissions from prescribed burning would increase from approximately 8 percent per year of the western Oregon total to a low of 15 percent per year under Alternative D and a high of 20 percent per year under Alternative C. The Proposed RMP prescribed fire greenhouse gas emissions would increase to 17 percent of the western Oregon prescribed fire emissions, or 0.28 Tg CO_2e per year, on average.

Issue 3

How would climate change interact with BLM management actions to alter the potential outcomes for key natural resources?

Summary of Analytical Methods

In this analysis, the BLM considered both how climate change would introduce uncertainty into outcomes described in other sections of this chapter and how the alternatives and the Proposed RMP might allow the BLM to undertake actions to adapt to climate change during plan implementation. The BLM described current and projected climate trends and analyzed how these trends could affect the resources described in other sections. The BLM then considered the extent to which the alternatives and the Proposed RMP would allow BLM to consider actions that promote adaptation to climate change during the implementation of the RMP.

The potential climate change impacts of most concern to the BLM are the indirect effects of changes in temperature, precipitation, and snow within the planning area, as these factors affect forest productivity and species composition, habitat for terrestrial and aquatic wildlife, and key disturbance regimes. This analysis focuses on the possible impacts to tree species composition and growth, fire regimes, insect outbreaks, certain diseases such as Sudden Oak Death and Swiss needle cast, stream flow and temperature