Chapter 3 – Affected Environment and Environmental Consequence

Introduction

This chapter describes the environment that the RMPs are likely to affect and the environmental consequences of the alternatives. Many EISs present the affected environment and environmental consequences in separate chapters. The BLM has combined these two topics into this single chapter to provide all of the relevant information on a resource in a single discussion.

This chapter includes sections on each resource that the RMPs are likely to affect. Each resource section begins with a summary of the methods used to analyze the effects of the alternatives on this resource. Each section includes one or more subsections that address a particular question about how the alternatives would affect the resource (the BLM refers to these questions as "issues"). Under each issue, the BLM describes the status and trends of the pertinent resource and then answers the question by describing the environmental consequences to the resource of the alternatives analyzed in detail, including the No Action alternative.

The Planning Area

The planning area includes approximately 2.5 million acres of Federal surface ownership and an additional 68,600 acres of Federal minerals with private surface ownership in western Oregon managed by the BLM's Coos Bay, Eugene, Medford, Roseburg, and Salem Districts and the Lakeview District's Klamath Falls Field Office (**Map 1-1**). Approximately, the entire planning area includes 22 million acres, but only 2.5 million acres, or 11 percent, are Federal lands administered by the BLM.[31] Private landowners own and manage the majority of lands within the planning area (**Figure 3-9).**

[31] As noted in Chapter 1, the BLM uses the term 'planning area' to refer to all lands within the geographic boundary of this planning effort regardless of jurisdiction and uses the term 'decision area' to refer to the lands within the planning area for which the BLM has authority to make land use and management decisions. Within the western Oregon districts, three BLM-administered areas are not included in the decision area: the Cascade Siskiyou National Monument (Medford District), the Upper Klamath Basin and Wood River Wetland (Klamath Falls Field Office), and the West Eugene Wetlands (Eugene District).

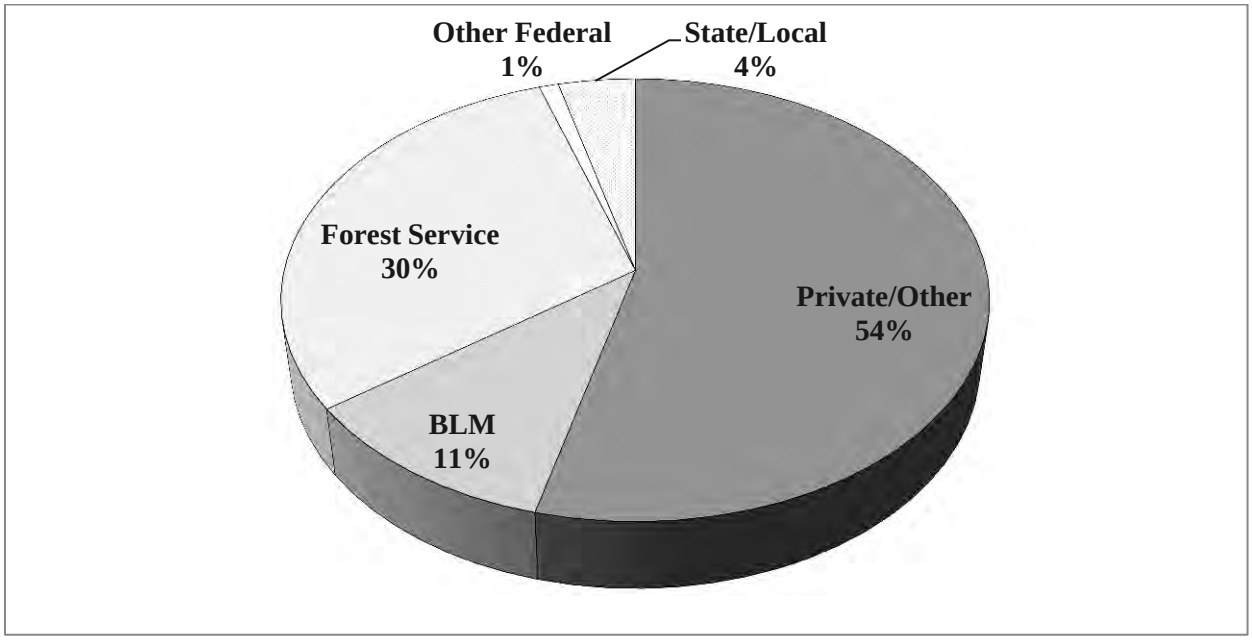


Figure 3-9. Major ownerships within the planning area.

There are five physiographic provinces within the planning area: Coast Range, Willamette Valley, West Cascades, Klamath, and East Cascades (**Figure 3-10**). The physiographic provinces vary in vegetation, hydrology, geology, and other processes (e.g., fire-return intervals) (FEMAT 1993).

Figure 3-10. Physiographic provinces within the planning area as described in FEMAT (1993).

The decision area includes O&C lands, Coos Bay Wagon Road lands, public domain lands, and acquired lands (**Map 1-2, Table 3-12**). The section "Major Authorizing Laws and Regulations" in Chapter 1 provides a description of the differing legal mandates that apply to these lands. The O&C lands are mostly scattered and intermingled with private, industrial forestlands. The O&C land pattern has a checkerboard character that results from the grid of the Public Land Survey System. The O&C lands are generally located in the odd-numbered sections, and the intermingled private lands are in the even-numbered sections. A section in the checkerboard is typically one mile on a side and encloses approximately 640 acres. About half of the public domain lands are scattered and intermingled with O&C lands, and the other half exist as larger blocks in the Salem, Coos Bay, and Lakeview BLM Districts (with the majority being concentrated in the Klamath Falls Field Office of the Lakeview District).

Table 3-12. Land status of the decision area.

Land Status	Acres	Percent of Decision Area
O&C Lands	2,025,826	81.2%
Coos Bay Wagon Road Lands	74,598	3.0%
Public Domain Lands	384,273	15.4%
Acquired Lands	8,958	0.4%
Totals	**2,493,655**	**100%**

Analytical Methodologies and Assumptions

This section describes the overall scope and analytical approach for this Draft RMP/EIS, as well as key analytical assumptions that are common to all analyses. The individual resource sections of this chapter and accompanying appendices include assumptions that are specific to that resource or program. In addition, Section C of the 2013 Planning Criteria for the RMPs for Western Oregon (Planning Criteria), which is incorporated here by reference, includes detailed descriptions of the assumptions that are specific to individual resources or programs (USDI BLM 2013, pp. 27-204). The individual resource sections in this chapter describe any substantial changes that the BLM has made to the methods and assumptions in the Planning Criteria since its publication.

Scope of the Analysis

The Council on Environmental Quality's regulations for implementing NEPA direct that "NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail" (40 CFR 1500.1[b]). Issues are "truly significant to the action in question" if they are necessary to make a reasoned choice between alternatives (i.e., the issue relates to how the alternatives respond to the purpose and need). Issues are also "truly significant to the action in question" if they relate to significant direct, indirect, or cumulative impacts caused by the alternatives. For this analysis, each resource section identifies the issues that are "significant to the action in question" and focuses the analysis on those issues.

The Council on Environmental Quality's regulations for implementing NEPA requires that an EIS disclose both the direct and indirect effects on the quality of the human environment of a proposed action or alternative.

Direct effects are those effects that are caused by the action and occur at the same time and place (40 CFR 1508.8(a)). For the most part, RMPs in and of themselves have minimal direct effects. This is because an RMP is typically implemented only through the approval of future proposed projects and activities consistent with the management direction of the RMP, and because there are numerous steps that must occur before any on-the-ground activities can actually occur. There are exceptions to this, in which an RMP could have direct effects on resources. For example, an RMP may designate an area as open to off-highway vehicle use, and thus the BLM would have no further decision-making before on-the-ground activities and effects on resources could occur. Additionally, an RMP may sometimes include implementation decisions within the RMP Record of Decision.

Indirect effects are those effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8(b)). With few exceptions as described above, the effects of an RMP represent indirect effects. That is, an RMP is designed to guide and control future management actions (43 CFR 1601.0-2), but those actions and their effects are later in time than the RMP Record of Decision. Although the specific timing, size, location, and design of future actions that would occur under each alternative are not certain, the BLM can project a reasonable forecast of future actions consistent with the management direction of the alternatives for the analysis in this Draft RMP/EIS. The section below on vegetation modeling includes more detailed description of this projection of future actions.

Cumulative effects result from the incremental impact of an action when added to past actions, other present actions, and reasonably foreseeable actions (40 CFR 1508.7). Due to the nature of the analysis in this large-scale and long-term planning effort, all environmental effects described in this Draft RMP/EIS would have incremental impacts that would have a cumulative effect together with past actions, other present actions, and reasonably foreseeable actions. Therefore, there is not a discrete and separate section

labeled as cumulative effects. The discussion of effects on each resource incorporates the effects of past actions, and describes other present actions and reasonably foreseeable actions to provide context in which the incremental effects are examined, thus revealing the cumulative effects of the alternatives.

As the Council on Environmental Quality points out, in guidance issued on June 24, 2005, the "environmental analysis required under NEPA is forward-looking," and review of past actions is required only "to the extent that this review informs agency decision making regarding the proposed action." Use of information on the effects of past actions may be valuable in two ways according to the Council on Environmental Quality guidance: for consideration of the proposed action's cumulative effects and as a basis for identifying the proposed action's direct and indirect effects.

The Council on Environmental Quality stated in this guidance that "[g]enerally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." This is because a description of the current state of the environment inherently includes the effects of past actions. The Council on Environmental Quality guidance specifies that the "[Council on Environmental Quality] regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions." The existing baseline information used in this analysis is a result of the aggregation of all past actions. The information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for a cumulative effects analysis than attempting to establish such a starting point by adding up the described effects of individual past actions to some environmental baseline condition in the past, which unlike current conditions can no longer be verified by direct examination.

The second area in which the Council on Environmental Quality guidance states that information on past actions may be useful is in "illuminating or predicting the direct and indirect effects of a proposed action." The basis for predicting the direct and indirect effects of this proposed action and its alternatives is published empirical research, the general accumulated experience of the resource professionals in the agency with similar actions, and using models based on current scientific knowledge regarding relationships of the proposed management directions and effects that are generally accepted by the scientific community in the various specialized fields.

Scoping for this project did not identify any need to list individual past actions nor to analyze, compare, or describe environmental effects of individual past actions in order to complete an analysis that would be useful for illuminating or predicting the effects of the proposed action.

In this Draft RMP/EIS, the BLM incorporated the effects of present actions into the description of the current condition, consistent with Council on Environmental Quality guidance and Department of Interior NEPA regulations at 43 CFR 46.115. For the purpose of this analysis, the BLM assumed that projects implementing the 1995 RMPs for which the BLM had made a decision prior to October 2012 have been implemented. For example, a timber sale sold prior to that date has been displayed and analyzed as harvested, whether or not that harvest has yet been completed. This assumption may overestimate the actual acreage harvested from sold sales, because some sales have not yet been harvested. This analytical assumption does not constitute a decision in principle about the disposition of these sales. The BLM integrated the effects of present actions on other ownerships into the broader analysis of current condition and assumptions about continued management consistent with existing plans or current trends.

For BLM-administered lands, reasonably foreseeable future actions are those actions that would occur as described under the various alternatives. For other ownerships within the planning area, reasonably foreseeable actions are those actions that would occur with the continuation of present management, also from a broad-scale perspective. It would be speculative for the BLM to presume knowledge of site-specific actions that would occur in the future on lands managed by others over the time period analyzed

in the Draft RMP/EIS. The BLM based these assumptions about future management on other ownerships on existing plans or current trends, and these assumptions are broad and general in nature. However, the broad assumptions are sufficient to provide context for evaluating the incremental effect of the alternatives.

There are other broad-scale analyses currently underway that the BLM consider as reasonably foreseeable actions for analyzing cumulative effects, including the U.S. Forest Service revision of the Okanagan-Wenatchee Forest Plans and the Jordan Cove Energy and Pacific Connector Pipeline Project.

Revision of the Okanagan-Wenatchee Forest Plans

The U.S. Forest Service is revising the land and resource management plans for the Okanogan-Wenatchee National Forests. The U.S. Forest Service released their Forest Plan Revision proposed actions on June 30, 2011, followed by a 90-day comment period that closed on September 28, 2011. The Proposed Action is the first formal step to developing the draft revised plans. The U.S. Forest Service has not yet released a draft EIS or published an expected timeline for release of a draft EIS. The revisions of these plans are reasonably foreseeable future actions, in that there are formal proposals for these plan revisions. However, it would be speculative of the BLM to project any specific effects related to these plan revisions, given the early stage of the planning process and the undefined timetable for completion of the plan revisions.

Jordan Cove Energy and Pacific Connector Pipeline Project

The Federal Energy Regulatory Commission released the Jordan Cove Energy and Pacific Connector Pipeline Project Draft EIS in November 2014 (FERC 2014). The BLM is a cooperating agency in the preparation of that draft EIS. Jordan Cove Energy Project, L.P. proposes to construct and operate a liquefied natural gas export terminal at Coos Bay, Oregon. Pacific Connector proposes to construct and operate an approximately 232-mile-long, 36-inch diameter underground welded-steel pipeline between interconnections with the existing interstate natural gas systems of Ruby Pipeline LLC and Gas Transmission Northwest LLC near Malin, Oregon, and the Jordan Cove terminal. Implementation of the Pacific Connector pipeline would require a right-of-way grant from the BLM to cross BLM-administered lands. If the Pacific Connector pipeline were to be implemented prior to this RMP revision, implementation would require RMP amendments of the Coos Bay, Roseburg, and Medford District RMPs. If the Pacific Connector pipeline were to be implemented after the completion of this RMP revision, and if the BLM were to adopt any of the action alternatives as described in this Draft RMP/EIS as the eventual RMP, implementation would require RMP amendments as well.

The pipeline would cross portions of Klamath, Jackson, Douglas, and Coos Counties, Oregon, including approximately 40 miles of BLM-administered lands. The construction of the pipeline would affect vegetation and habitat on approximately 800 acres of BLM-administered lands: 61 acres of urban-built-up and transportation-utility lands, less than 0.1 acre of agricultural land, 62 acres of rangeland, 674 acres of forest, 0.8 acre of wetlands, 1 acre of water, and 2 acres of barren lands/quarries. The construction of the pipeline would require the temporary clearing of vegetation within a 95-foot-wide construction right-of-way. During operation of the pipeline, a 30-foot-wide corridor centered on the pipeline would be kept in an herbaceous state, resulting in a permanent loss of forest. Across all ownerships, the construction of the pipeline would result in the clearing of 2,108 acres of forest and the permanent loss of 542 acres of forest. The potential effects of this proposed action on vegetation and habitat are described in more detail in the Jordan Cove Energy and Pacific Connector Pipeline Project Draft EIS, which is incorporated here by reference (FERC 2014, pp. 4-12 – 4-241; 4-369 – 4-546).

No Federal lands would be utilized for the Jordan Cove LNG terminal. Construction of the LNG terminal and associated facilities would affect a total of approximately 397 acres, of which 178 acres are currently industrial land, 111 acres forest land, 76 acres open land (including shrubs and grasslands), and 32 acres of open water. Permanent operation of the facilities would affect approximately 251 acres, of which 68 acres are open land, 76 acres industrial, 76 acres forest, and 32 acres open water. The potential effects of the construction and operation of the Jordan Cove LNG terminal are described in more detail in the Jordan Cove Energy and Pacific Connector Pipeline Project Draft EIS, which is incorporated here by reference (FERC 2014, pp. 4-2 – 4-11).

The Jordan Cove Energy and Pacific Connector Pipeline Project is a reasonably foreseeable future action, in that there is a formal proposal for the project. This Draft RMP/EIS addresses the cumulative effects of the Jordan Cove Energy and Pacific Connector Pipeline Project together with the effects of this proposed action in those specific resource sections for which analysis at this scale would provide meaningful information. However, the BLM did not explicitly incorporate potential future effects of the project, such as removal of vegetation and habitat along the proposed pipeline route, into the modeling for this analysis, because the modeling would not be able to detect or parse out any cumulative or synergistic effect due to the small acreage and localized effects of the proposed pipeline project. The vegetation clearing for the proposed pipeline would affect less than 0.1 percent of the BLM-administered lands in the planning area, which represents an exceedingly small portion of the decision area as a whole. Furthermore, the area that the pipeline would affect would be spread out across the Klamath Falls Field Office, Medford, Roseburg, and Coos Bay Districts, further attenuating the potential effects on vegetation and habitat that could be detected at this scale of analysis. Finally, the vegetation clearing for the proposed pipeline would occur as a narrow feature on the landscape, cutting across forest stands, rather than removing forest stands. Such a small overall acreage, spread out over multiple administrative units, as a narrow feature on the landscape would not reflect any meaningful differences in the vegetation modeling at this scale of analysis and would not have the potential to alter any of the analytical conclusions related to vegetation and habitat in this analysis. If constructed as described in the proposed action, the Jordan Cove Energy and Pacific Connector Pipeline Project would disturb and remove too little acreage of vegetation and habitat and therefore would not generate any relevant information that could be meaningfully included in the vegetation and habitat modeling of approximately 2.5 million acres on BLM-administered lands in this Draft RMP/EIS.

The BLM would address the cumulative effect of BLM implementation actions together with the effects of the Jordan Cove Energy and Pacific Connector Pipeline Project in project-level NEPA analysis, as appropriate. Project-level cumulative effects analysis would include the Jordan Cove Energy and Pacific Connector Pipeline Project if the effects of the Jordan Cove Energy and Pacific Connector Pipeline Project would be within the geographic and temporal scope of the effects of the BLM implementation action and would have a combined effect with the BLM implementation action (see generally USDI BLM 2008, pp. 57-61). The BLM would be better able to address the cumulative effects of the Jordan Cove Energy and Pacific Connector Pipeline Project together with BLM actions in project-level NEPA analysis than in this Draft RMP/EIS, given the small acreage and localized effects of the Jordan Cove Energy and Pacific Connector Pipeline Project.

Irreversible and Irretrievable Commitment of Resources

The Council on Environmental Quality's regulations for implementing NEPA require that an EIS discussion of environmental consequences include "any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented" (40 CFR 1502.16). Irreversible or irretrievable commitments of resources are those that

cannot be reversed or that are lost for a long period. Examples include the extraction of minerals or the commitment of land to permanent roads. Although not specifically labeled, adverse environmental effects, the relationship between short-term uses and long-term productivity, and the irreversible and irretrievable commitment of resources are described, by resource, throughout the discussion of environmental consequences in this chapter.

Spatial and Temporal Scales of Analysis

The spatial and temporal scale of analysis varies by resource and by issue. Consistent with the BLM NEPA Handbook, the spatial and temporal scale of analysis should be bounded by the extent and duration of the direct and indirect effects of the proposed action (USDI BLM 2008, p. 58).

For some issues in this Draft RMP/EIS, the spatial scale is broader than the planning area. For other issues, the spatial scale is highly limited because of the nature of the resource and the potential effects of the proposed action on the resource. The individual resource sections of this chapter and accompanying appendices include descriptions of the spatial scales of analysis that are specific to that resource or program.

Specifying the temporal scale of analysis for an RMP/EIS is more challenging than for a discrete, site-specific action. Analysis of the effects of an RMP includes projecting future implementation actions. Because it is not possible to forecast the duration of the RMP itself, it is not possible to determine the duration of the effects of implementing the RMP. Instead, most analyses in this Draft RMP/EIS set the temporal scale of analysis based on a time frame that illuminates differences in the outcomes under the alternatives. For most analyses, this temporal scope extends beyond any reasonable anticipation of RMP implementation, because analysis of effects of different land management on many resources must be extended for many decades to show any discernable differences. Limiting the temporal scope of analysis to the anticipated duration of the RMP, such as one or two decades, would obscure differences in effects among the alternatives and thus fail to provide a clear basis for choice among alternatives. The individual resource sections of this chapter and accompanying appendices include descriptions of the temporal scales of analysis that are specific to that resource or program.

The temporal scope for the determination of the annual productive capacity for sustained-yield timber production for each alternative is somewhat different that for the other analyses, in light of the BLM's mandate for sustained-yield timber production under the O&C Act, as discussed in Chapter 1. The determination of the annual productive capacity for each alternative extends for 200 years, far beyond any reasonable anticipation of RMP implementation. The temporal scope for this determination extends beyond the other analyses to ensure that the BLM could produce the determined annual productive capacity of timber without any decline, even in future decades.

Data Used in this Analysis

The analyses in this Draft RMP/EIS use multiple data sources. Acreage totals for the planning area and the decision area vary based on how the BLM assembles the data to address the specific issue in question. The precise acreage of the planning area depends on what area the BLM includes within the geographic boundary of this planning effort, such as offshore areas within the official BLM district boundaries or areas within the geographic boundaries of separate BLM RMPs, ranging from 22,096,899 acres to 22,928,632 acres. In addition, the differing data sources for BLM-administered lands and other lands complicate combining acreage totals across ownerships. Similarly, the precise acreage of the decision area depends on the data source for defining BLM-administered lands within the planning area, ranging from 2,478,856 acres to 2,493,655 acres. Because of these varying acreages from various data sources, the acreage totals are not precisely the same in all resource sections of this analysis. The individual

resource sections of this chapter and accompanying appendices include descriptions of the data sources that are specific to that resource or program.

The data that the BLM used in this analysis is at a far finer resolution than was available for the Northwest Forest Plan and the 1995 RMPs. The data for most of the analyses in this Draft RMP/EIS (such as the vegetation modeling described below) is at a resolution of units of 100 square meters in size, which is more than 1,600 times finer in resolution than the data available for the Northwest Forest Plan. As a result, this analysis can more precisely map resource conditions and accurately include fine-scale features, such as streams and roads, which the BLM could not previously consider. The data summaries in the analyses in the Draft RMP/EIS do not always reflect the precision of the underlying data. In many of the analyses, the BLM rounded acreage numbers to ensure that the precision of analytical results does not exceed the accuracy associated with the analytical assumptions. The BLM only requires sufficient precision of the analytical results to illustrate the comparative effects caused by the alternatives to support reasoned decision-making.

Analytical Assumptions about RMP Implementation

For the purpose of this analysis, the BLM assumed full and immediate implementation of each of the alternatives from the date of the decision. That is, the BLM has modeled and analyzed implementation of actions at the level directed by each alternative from January 2013 forward, as discussed further in the following section. For some alternatives, especially those that differ substantially from the current implementation of the 1995 RMPs, the necessary organization transition may take several years before the BLM would be able to implement a new RMP fully. For example, if the amount of timber harvest under a new RMP were to be substantially higher than the current timber harvest levels, the BLM might need up to five years to reach full implementation of the new RMP, given the time required to plan, prepare, and implement new timber sales. If the amount of timber harvest under a new RMP were to be similar to or lower than the current timber harvest levels, a lengthy transition period would not be required. Due to the speculative nature of this transition period and the widely varying difference in the alternatives from the current implementation of the 1995 RMPs, the BLM does not attempt to account for this transition period in the analysis of effects in the Draft RMP/EIS. If the eventual Proposed RMP differs substantially from the current implementation of the 1995 RMPs, such that the BLM anticipates a lengthy transition period, the BLM will address this transition period in the analysis for the Proposed RMP/Final EIS.

For the purpose of this analysis, the BLM assumed adequate funding and staffing to implement the alternatives as described.

Vegetation Modeling

The BLM used the Woodstock model as part of the Remsoft Spatial Planning System 2012.12.0 to simulate the management and development of the forested BLM-administered lands over time. The alternatives outline a range of approaches for managing BLM-administered lands by varying the land allocations and intensity with which the BLM manages these forests. These different approaches would result in a range of outcomes, habitat characteristics, and timber harvest levels. The Woodstock model simulated the application of management practices and forest development assumptions to characterize the forest in 10-year increments into the future. The Planning Criteria includes a description of the vegetation modeling in detail, including an explanation of why the BLM chose the Woodstock model over other types of models to conduct this analysis, and that discussion is incorporated here by reference (USDI BLM 2014, pp. 28-33). In addition, **Appendix C** provides detailed and technical information on the vegetation modeling.

The BLM mapped lands that would be allocated for sustained-yield timber production and lands that would be allocated to reserve land use allocations under each alternative. For each land use allocation, the BLM described treatments to reflect the management direction for each alternative. Within the Woodstock model, these treatments define the forest management activities that could occur for an individual stand. The BLM used the ORGANON growth model, version 9.1 (http://www.cof.orst.edu/cof/fr/research/organon/) to simulate the growth of stands through time.

The Woodstock model used starting conditions of the forest vegetation, treating January 2013 as analysis year zero. The BLM used information on forest conditions in the Woodstock model from three sources. The first is the Forest Operations Inventory, which contains information on forest stand condition for approximately 69,600 stands. The second source of vegetation information is the Current Vegetation Survey, which is a systematic, permanent plot grid inventory that has installed one plot every 1.7 miles on forested BLM-administered land. The third source is the BLM geographic information system, which contains information describing aspects of the environment that affect where timber harvest could take place. These include the productive capacity of the land, as well as threatened, endangered, and special status plant species locations.

The BLM incorporated into the Woodstock model a scenario for future wildfires in the planning area. **Appendix D** provides a detailed and technical description of the development of the wildfire scenario. To model the locations of these future wildfires, the BLM used the wildfire suitability model developed as part of the 15-year monitoring report for the Northwest Forest Plan (Davis *et al.* 2011). This model was based on the occurrence of large wildfires from 1970-2002, and represents a probability surface for large wildfire occurrence within the northern spotted owl range.

The BLM modelled this future wildfire scenario consistently for all alternatives. It is possible that management actions such as timber harvest and fuels treatments would alter the likelihood or severity of future wildfires and those management actions would vary by alternative. Nevertheless, it is not possible to model different future wildfire scenarios under different alternatives, given the following:

- The inherent challenges in predicting the location and timing of future stochastic events
- The inability at this scale of analysis to forecast the site-specific location and conditions of future management actions
- The uncertainty around the site-specific effects of individual management actions on the likelihood of wildfire occurrence and severity

Although it is possible that the alternatives would differentially affect how future wildfires would occur, such differences are not reasonably foreseeable at this scale of analysis. Therefore, it would be speculative to forecast different future wildfire scenarios under different alternatives. **Appendix D** provides more detailed discussion of the role of forest management actions in modeling the future wildfire scenario.

The BLM also modelled this future wildfire scenario based on past wildfire occurrence and did not incorporate projections of the effects of climate change on future wildfire occurrence and severity. As discussed later in this chapter, there is evidence that the fire season is becoming longer, potential fire severity is increasing in the planning area, and that climate change may be contributing to these trends. However, the inherent challenges in predicting future stochastic events coupled with the uncertainties in climate change predictions make it impossible to forecast specifically when and where future wildfires would occur differently than they have occurred in the recent past. **Appendix D** provides more detailed discussion of the role of climate change predictions in modeling the future wildfire scenario.

The BLM did not incorporate projections of future windstorms, disease outbreaks, or insect infestations into the simulation of the growth of stands through time within the Woodstock model. These disturbances will occur in the future under all alternatives, but predicting their location, timing, severity, and extent would be speculative. Unlike the wildfire suitability model reference above, there are no available theoretical approaches for estimating the location, timing, or severity of future windstorms, disease outbreaks, or insect infestations at the scale of the planning area over the time frame of this analysis.

The BLM did not incorporate projections of climate change into the simulation of the growth of stands through time within the Woodstock model. That is, the BLM modelled the management and development of the forested BLM-administered lands over time assuming that forest stands will continue to grow and respond to treatments in the future the same as they do now. There are substantial uncertainties in predicting how and when climate conditions will change at the regional scale, as discussed in detail later in this chapter. In addition to the uncertainty in climate change predictions, the available climate predictions cannot be downscaled to a meaningful level for use in forest stand growth and harvesting models. To translate these broad regional predictions with substantial uncertainties to projections of how and when specific groups of forest stands would change in their patterns of growth and response to treatment over the next several decades would be so speculative as to be arbitrary. Separate from the vegetation modeling with Woodstock, the BLM did review bioclimatic envelope model projections and evaluate the potential effects and associated uncertainty of projected climate changes on a variety of forest management outcomes for the planning area conducted using the Climate extension of the Forest Vegetation Simulator model. The climate change section in this chapter includes detailed discussions of these specific analytical efforts.

The BLM used the Woodstock model to simulate forest development within the decision area. On other land ownerships within the planning area, the BLM used an estimation of future forest conditions by applying assumptions to the 2006 version of the gradient nearest neighbor (GNN) imputation and Landsat time-series data (Ohmann *et al.* 2012). The BLM estimated future forest conditions on other land ownerships assuming that other landowners would continue to implement their present management.

The BLM did not use the Woodstock model to model vegetation change on the Eastside Management Area land use allocation (i.e., BLM-administered lands in the Klamath Falls Field Office east of Highway 97), because most of these lands are not in a forested condition. These lands do not include any O&C lands and are outside of the range of the northern spotted owl.

Vegetation Modeling Products

For each alternative, the Woodstock model projected development of the forest under the alternatives for many decades into the future. The model tracked the types of forest management treatments over time (short- and long-term), both numerically and spatially. The modeling utilized both numeric and spatially-explicit displays of development of the forest over time.

Within the modeling, the BLM described all land in the decision area as non-forest, woodland, or forested. The non-forested land includes sagebrush, grassland, water and other areas that are not expected to have forests within the time of the analysis. The woodland includes juniper and Oregon white oak plant associations, and other areas that have trees, but the BLM does not expect them to maintain a closed forest canopy.

Forest conditions at the scale of the planning area are discussed in terms of the structural stages of forests. Various interdisciplinary team members in their analysis used this common definition. The structural stage definitions rely heavily on the structural stage definitions that the BLM developed in the 2008 EIS, with one addition. The 2008 analysis divided the forest structure into four classifications (stand

establishment, young, mature, and structurally-complex). The forest structure definitions used in this analysis include all of the 2008 definitions, as well as the new category of early-successional.

The BLM defined each of the structural stages for 'moist' and 'dry' forests. The BLM developed a map that labels all lands in the decision area as either moist or dry. The final groupings have incorporated recommendations from the BLM offices[32], and are similar to, but do not always correspond exactly to mapped plant series, or plant association groupings. In general, the moist forest includes western hemlock, Sitka spruce, Pacific silver fir, Shasta red fir, and tanoak plant associations. The dry forest includes Douglas-fir, Jeffery pine, grand fir, white fir, and ponderosa pine plant associations.

The structural stage definition further differentiates early-successional, stand establishment, and young structural stages by the presence or absence of structural legacies. For the purpose of this definition, a structural legacy is a tree that is 20 inches or larger diameter at breast height and is larger and older than other trees in the stand. The 2008 EIS provides more detailed information on the stand establishment, young, mature, and structurally-complex structural stages and is incorporated here by reference (USDI BLM 2008, pp. 206-211 and Appendix B, pp. 12-15).

The BLM defined the early-successional category to describe forested land that has low canopy cover and younger, shorter trees than the stand establishment stage. The early-successional structural stage has trees that are less than 50 feet tall and less than 30 percent canopy cover. Some combination of shrubs, grasses, and forbs appear visually dominant and are ecologically dominant at the beginning of this stage. The stand establishment structural stage has similar characteristics but has greater than 30 percent canopy cover, such that trees are both visually and ecologically dominant.

The following outline shows the different structural stages that the BLM used in this analysis:

- Non-forest
- Woodland
- Forest
  - Early-successional
    - With Structural Legacies
    - Without Structural Legacies
  - Stand Establishment
    - With Structural Legacies
    - Without Structural Legacies
  - Young High Density
    - With Structural Legacies
    - Without Structural Legacies
  - Young Low Density
    - With Structural Legacies
    - Without Structural Legacies
  - Mature
    - Single Canopy
    - Multiple Canopy
  - Structurally-complex
    - Existing Old Forest

[32] Since there are 5 Districts and 1 Field Office, for the rest of this analysis, these will be referred to as BLM offices or offices.

- Existing Very Old Forest
- Developed Structurally-complex

The BLM used the modeling output from this five-tiered structural stage definition to help assess changes in the forested landscape over time, including evaluating habitat conditions for most wildlife species other than the northern spotted owl.

The modeling also provided species-specific outputs on habitat conditions for the northern spotted owl. The BLM used these outputs in species-specific modeling as inputs for other models to analyze the effects of the alternatives on northern spotted owl habitat and populations, as discussed in detail later in this chapter.

The modeling also provided outputs related to timber production, including calculation of the annual productive capacity for sustained-yield timber production under each alternative. The BLM calculated the annual productive capacity for each of the six sustained yield units, which match the five western Oregon BLM district boundaries and the western portion of the Klamath Falls Field Office in the Lakeview District. The BLM constrained the calculation of the annual productive capacity to the volume of timber that could be produced continuously for 200 years with the management practices described in the alternatives from those lands allocated to the Harvest Land Base. Both the management practices and the lands allocated to the Harvest Land Base would vary among the alternatives, and, consequently, the calculated annual productive capacity varies among the alternatives as well.

The modeling also provided outputs related to timber production from the reserve land use allocations under each alternative. Both the management direction for reserve land use allocations and the lands allocated to the reserve land use allocations would vary among the alternatives, and, consequently, the calculated timber production from the reserve land use allocations varies among the alternatives as well. Unlike the annual productive capacity, this timber production would also vary over time for each alternative, because timber harvest would occur as a by-product of forest management treatments for purposes other than sustained-yield timber production.

The BLM used these modeling outputs related to timber production as inputs for other models to analyze the effects of the alternatives on socio-economic conditions, including employment and earnings, payments to the counties, and implementation costs to the BLM, as discussed in detail later in this chapter.

Analysis of Sub-alternatives

As explained in Chapter 2, sub-alternatives are variations of an action alternative that modify an individual component of the alternative to explore how the changes would alter certain outcomes. In this Draft RMP/EIS, the BLM has developed Sub-alternatives B and C, which are sub-alternatives of Alternative B and Alternative C, respectively. Both of these sub-alternatives vary the design of the Late-Successional Reserve to explore how the changes would modify outcomes for forest management and northern spotted owls. Because these sub-alternatives vary only this component of the alternatives and all other components of the alternative remain unchanged, the analysis of the sub-alternatives in this Draft RMP/EIS only includes the effects on forest management and northern spotted owls.

Reference Analysis

A reference analysis of No Timber Harvest is included in this Draft RMP/EIS. The BLM includes this reference analysis to provide additional information for interpreting the effects of one or more of the alternatives. The No Timber Harvest Reference Analysis is not a reasonable alternative, because it would

not meet the purpose and need for action. However, this reference analysis provides information about the biological capabilities of the decision area in the absence of timber harvest and affords a point of comparison in the effects analysis of the alternatives. The discussion of the reference analysis is not comprehensive, as it is not a reasonable alternative. Instead, the BLM described outcomes under the No Timber Harvest Reference Analysis only for those issues for which it is useful in interpreting the effects of one or more of the alternatives.

References

Davis, R. J., K. M. Dugger, S. Mohoric, L. Evers, and W. C. Aney. 2011. Status and trends of northern spotted owl populations and habitats. General Technical Report PNW-GTR-850. USDA FS, Pacific Northwest Research Station, Portland, OR. 147 pp. http://www.fs.fed.us/pnw/pubs/pnw_gtr850.pdf.

FEMAT. 1993. Forest ecosystem management: an ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team (FEMAT). 1993-793-071. Washington, DC: GPO.

USDI BLM. 2008. Final Environmental Impact Statement for the Revision of the Resource Management Plans of the Western Oregon Bureau of Land Management Districts. Oregon State Office. Portland, OR. Vol. I-IV.

USDI BLM. 2014. Resource management plans for western Oregon planning criteria. Bureau of Land Management, Oregon/Washington State Office, Portland, OR. http://www.blm.gov/or/plans/rmpswesternoregon/plandocs.php.

Federal Energy Regulatory Commission. (FERC). 2014. Draft Environmental Impact Statement – Jordan Cove Energy and Pacific Connector Pipeline Project. Washington, D.C. Vol. I-II

Ohmann, J. L., and M. J. Gregory. 2002. Predictive mapping of forest composition and structure with direct gradient analysis and nearest-neighbor imputation in coastal Oregon, USA. Canadian Journal of Forest Research **32**(4): 725-741. dx.doi.org/10.1139/X02-011.

Air Quality

Key Points

- All action alternatives are expected to produce more particulate emissions than the No Action alternative and current conditions; however, adherence to the requirements of the Oregon Smoke Management Plan should continue to limit impacts to human health and visibility from prescribed fires.
- Based on the amount of area where active management would occur, Alternative C has the greatest potential to reduce adverse effects to human health and visibility from wildfires over the long-term while the No Action likely would have the least effect.

Issue 1

How will the proposed management actions affect $PM_{2.5}$, PM_{10}, and expected visibility?

Summary of Analytical Methods

The Woodstock model produced estimates of the acres of activity fuels treatments by treatment type (e.g., hand pile burning, machine pile burning, broadcast burning) for each alternative. The team fuels specialist provided pile dimensions, estimates of the number of piles per acre, and the amount of fuel typically consumed in broadcast burns. The fuels specialist provided similar details for the hazardous, or natural, fuels program along with the expected acres of each treatment type for each district. These details were used in Consume 3.0 to estimate particulate emissions. 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 2014, pp. 33-35). Data sources include annual smoke reports from the Oregon Department of Forestry (available at http://www.oregon.gov/odf/pp./fire/smp/smkmgtannualrpts.aspx) and visibility information from the Interagency Monitoring of Protected Visual Environments (IMPROVE) program (available at http://vista.cira.colostate.edu/improve/) for the existing condition. Appendix E contains a more detailed description of the analytical methods used to estimate particulate emissions from prescribed burning and wildfires.

Background

Western Oregon has a history of air quality problems due to the combination of weather patterns and topography. Poor air quality develops when a major polluting activity or event combines with temperature inversions and strong high pressure systems that create stagnant air. The topography of the planning area contains several bowls that trap and concentrate pollutants in valley bottoms, exacerbating the effects of stagnant air. The worst air quality in winter typically occurs due to the combination of a strong and persistent inversion, high vehicle use, and biomass consumption associated with heat or power generation (particulates) (ODEQ 2012). The worst air quality in summer typically occurs due to the combination of strong persistent high pressure and high vehicle use (ozone) or widespread and large wildfires (particulates, ozone). Sources of pollutants may be chronic, such as from a factory or homes heating with wood during the winter, or transient, such as from prescribed burning or wildfires. Pollutants from BLM land management activities or wildfires can exacerbate existing air quality problems.

Smoke from prescribed fire and wildfire produces carbon monoxide, nitrogen oxide compounds, and particulates, along with certain air toxics such as acrolein, benzene, and formaldehyde. The main criteria pollutant of concern for BLM management activities is particulate matter (PM_{10} and $PM_{2.5}$) (ODEQ 2003, 2009, 2012, 2013a); in addition to posing a human health risk due to their small size, particulate matter from wildland fuels are excellent at scattering light, thereby reducing visibility. Carbon monoxide, on the other hand, while a substantial human health risk, dilutes rapidly, making it a hazard to firefighters only. The concentration of air toxics found in smoke are typically very low with regulations focused on industrial and commercial sources, vehicle emissions, and indoor air. Prescribed fire and wildfire do not produce ozone directly, but do produce two additional pollutants, nitrogen oxides (NO_x) and volatile organic compounds (VOCs), which are precursors for ground-level ozone under certain conditions.

The Oregon Department of Environmental Quality (ODEQ) Air Quality Division implements the U.S. Environmental Protection Agency's (EPA's) air quality regulations and this division has delegated smoke management responsibilities to the Oregon Department of Forestry (ODF). All prescribed burning in western Oregon is conducted under requirements in the Oregon Smoke Management Plan (http://arcweb.sos.state.or.us/pp./rules/oars_600/oar_629/629_048.html). This plan requires dispersion, dilution, and avoidance techniques to minimize smoke impacts on mandatory Class 1 areas, designated air quality non-attainment and maintenance areas, and smoke sensitive receptor areas. Mandatory Class 1 areas are areas, such as Congressionally-designated wilderness areas, identified under the Clean Air Act as requiring the highest level of protection.[33] Non-attainment and maintenance areas are areas that are either not attaining, or have a history of not attaining, the National Ambient Air Quality Standards. A Smoke Sensitive Receptor Area is an area that has the highest level of protection under the Oregon Smoke Management Plan due to a history of smoke incidents, its' population density, or from a legal protection related to visibility.

Visibility is protected in mandatory Class I areas as required by the Clean Air Act. The goal of the Regional Haze Rule (a part of the Clean Air Act) is to reduce haze in mandatory Class I areas to naturally occurring levels by 2064. Because visibility varies day by day, the rule requires that visibility on the 20 percent worst-case days be reduced to natural background conditions while ensuring no degradation of the 20 percent best-case days. States are to take reasonable measures to make progress towards this goal.

Crater Lake National Park and the Kalmiopsis, Mt. Hood, Three Sisters, Mt. Jefferson, Mt. Washington, Diamond Peak, Gearhart Mountain, and Mountain Lakes wildernesses are mandatory Class 1 areas within the air quality analysis area. Of these areas, visibility monitoring occurs at Crater Lake National Park and the Kalmiopsis, Three Sisters, and Mount Hood wilderness areas. Visibility is measured in deciviews with the lower the number, the better the visibility. The Interagency Monitoring of Protected Visual Environments (IMPROVE) program monitors air quality and visibility at selected mandatory Class 1 areas and has established natural condition deciviews at each monitored site for the clearest and haziest days. The program estimates annual values and trends for the clearest days and haziest days since 2003 (data summaries available at http://views.cira.colostate.edu/fed/AqSummary/VisSummary.aspx?siidse=1).

[33] Mandatory Class 1 Areas. Include 156 National parks, Wilderness Areas, international parks, and other areas identified by Congress in the 1977 amendment to the Clean Air Act. The areas designated include all National parks greater than 6000 acres in size and all designated wilderness areas and National memorial parks greater than 5000 acres in size in existence as of August 1977. The amendment also set a visibility goal for these areas to protect them from future human-caused haze, to eliminate existing human-caused haze, and require reasonable progress toward that goal.

The EPA regulates air quality under the Clean Air Act to protect human health and welfare, with visibility in mandatory Class 1 areas serving as the indicator for human welfare with respect to smoke. EPA has established National Ambient Air Quality Standards (NAAQS)[34] for seven criteria pollutants (**Table 3-13**). The primary standard addresses human health and the secondary standard human welfare.

Table 3-13. Criteria pollutants regulated under the Clean Air Act and the current NAAQ standards for each.

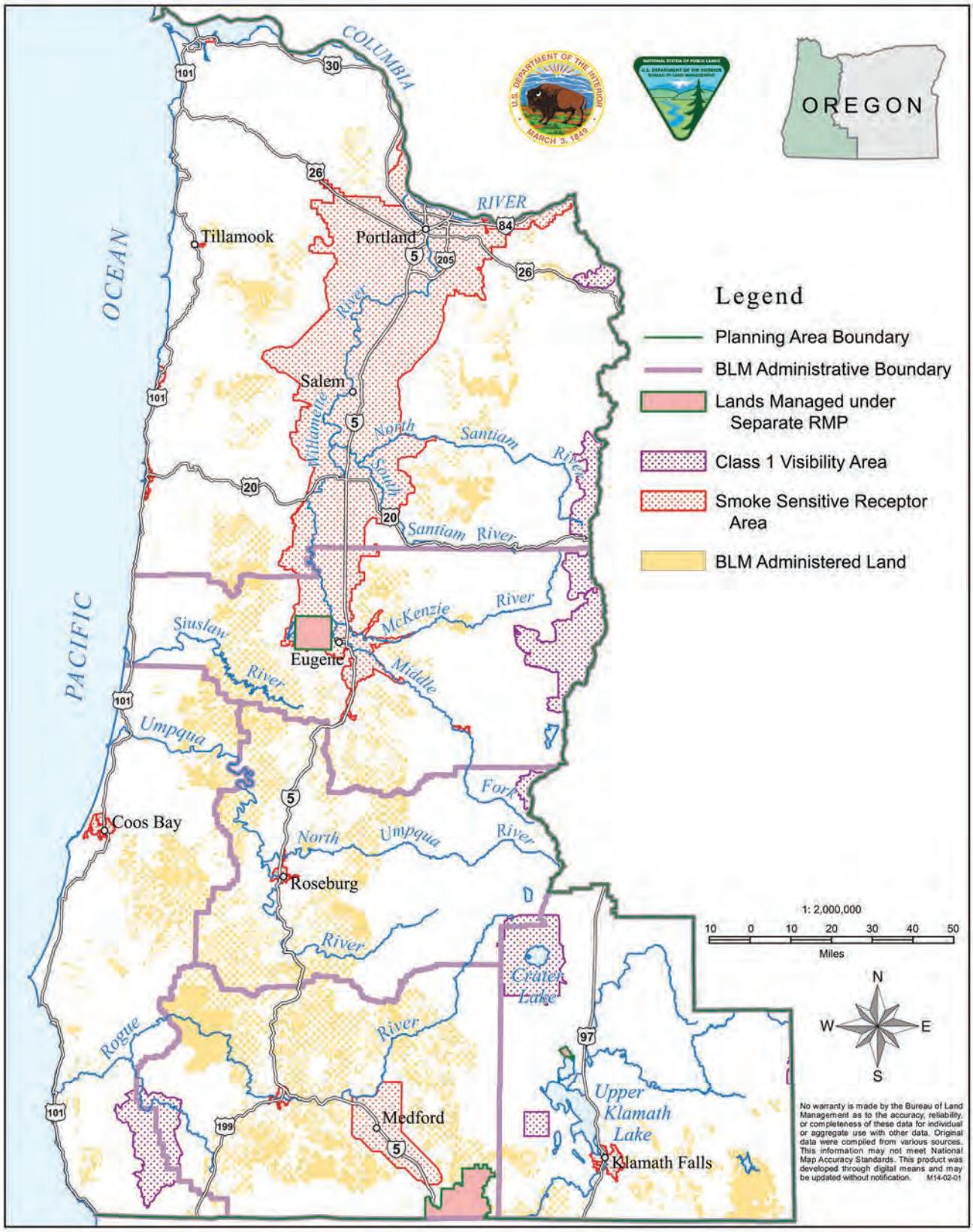
Pollutant	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)	Primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	
Lead	Primary and Secondary	Rolling 3 month average	0.15 $\mu g/m^3$	Not to be exceeded
Nitrogen Dioxide (NO_2)	Primary	1-hour	100 ppb	98th percentile, averaged over 3 years
	Primary and Secondary	Annual	53 ppb	Annual mean
Ozone (O_3)	Primary and Secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
$PM_{2.5}$	Primary	Annual	12 $\mu g/m^3$	Annual mean, averaged over 3 years
	Secondary	Annual	15 $\mu g/m^3$	Annual mean, averaged over 3 years
	Primary and Secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
PM_{10}	Primary and Secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)	Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year.

ppm = parts per million, ppb = parts per billion, μg = micron

Air quality non-attainment areas include Eugene-Springfield and Oakridge for PM_{10}, and Oakridge and Klamath Falls for $PM_{2.5}$. Portland-Vancouver and Salem are air quality maintenance areas for ozone. The Oregon Smoke Management Plan identifies the following Smoke Sensitive Receptor Areas (SSRAs) within the planning area (**Map 3-1**):

- The cities of Carlton, Corvallis, Cottage Grove, Eugene, McMinnville, Portland, Sheridan, Silverton, Springfield, St. Helens, Stayton, Sublimity, Veneta, Willamina, and Yamhill;
- The acknowledged urban growth boundaries of the following cities: Astoria, Coos Bay, Grants Pass, Klamath Falls, Lakeview, Lincoln City, Newport, North Bend, Oakridge, Roseburg, and Tillamook;
- The area within the Bear Creek and Rogue River Valleys described in OAR 629-048-0160, including the cities of Ashland, Central Point, Eagle Point, Jacksonville, Medford, Phoenix, and Talent; and
- The area within the Columbia River Gorge Scenic Area, as described in 16 U.S.C. section 554b (2003).

[34] National Ambient Air Quality Standards- Specific target threshold concentrations and exposure durations of six pollutants based on criteria gauged to protect human health and the welfare of the environment.



Map 3-1: Smoke Sensitive Receptor Areas as Described in the Oregon Smoke Management Plan

BLM must register all prescribed burns on BLM-administered lands within the planning area with ODF. The registration includes the location, the planned date and time of ignition, and the estimated fuel load and consumption. The day before each planned burn, ODF meteorologists evaluate this information along with the forecasted weather for the next day to determine whether smoke from a given burn is likely to enter a SSRA. Meteorologists must not knowingly allow a burn to occur which will cause an intrusion of smoke into an SSRA. Thus, each day these meteorologists create burn instructions for different parts of the forest region to prevent smoke from entering SSRAs. The BLM must follow these instructions.

The air quality index is widely used to report relative daily air quality in a common framework related to potential impacts to human health (**Table 3-14**). Index values range from 0 to 300 and are typically displayed in a color-coded table or graph. The higher the value, the greater the level of air pollution and the greater the human health concerns. The air quality index is based on the combined 24-hour concentrations of $PM_{2.5}$ and O_3. As pollution standards are changed, the formula used to calculate the air quality index is also adjusted in order to maintain the relationship to human health concerns.

Table 3-14. Air Quality Index (AQI) with health advisories.

Air Quality	Air Quality Index	Health Advisory
Good	0-50	No health impacts expected.
Moderate	51-100	Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion.
Unhealthy for Sensitive Groups	101-150	People with heart disease, respiratory disease (such as asthma), older adults, and children should reduce prolonged or heavy exertion. Active healthy adults should also limit prolonged outdoor exertion.
Unhealthy	151-200	People with heart disease, respiratory disease (such as asthma), older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy outdoor exertion.
Very Unhealthy (Alert)	201-300	People with heart disease, respiratory disease (such as asthma), older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.

Ozone Maintenance Areas

Prescribed burning produces precursor emissions (e.g., oxides of nitrogen (NO_x) and volatile organic compounds (VOCs)) that under higher temperatures and sunny days produce ground-level ozone. However, BLM prescribed burning activities are projected to be a long distance from the two ozone maintenance areas within the planning area. As a result, effects would be expected to be very low for the precursors of ozone. Local vehicular traffic in Portland, Vancouver, and Salem represents a primary source of air emissions that may lead to the development of ozone. Furthermore, the highest levels of ozone in the maintenance areas occur during summer while the greatest activity for prescribed burning is during spring and fall. Therefore, it is very unlikely that any of the alternatives would have a notable effect on problematic ozone levels in the planning area and are not analyzed for this pollutant.

Conformity

The General Conformity Rule (a part of the Clean Air Act) applies to Federal actions occurring in non-attainment or maintenance areas when the net change in total direct and indirect emissions of non-attainment pollutants (or their precursors) exceeds specific thresholds (known as *di minimis* levels). The intent of the General Conformity requirements is to prevent the air quality impacts of Federal actions from causing or contributing to a violation of the National Ambient Air Quality Standards (EPA 2013) or interfering with the purpose of the State Implementation Plan. This means that under the Clean Air Act, Section 176 and 40 CFR, Part 93, Subpart W, Conformity Rules (available at

http://www.epa.gov/air/genconform/), Federal agencies must make a determination that proposed actions in Federal non-attainment areas conform to the applicable EPA-approved State Implementation Plan before an action is taken.

All prescribed burns within western Oregon must comply with the Oregon Smoke Management Plan, which prohibits smoke intrusions into smoke sensitive receptor areas. As a result, the Conformity Rule is not applicable for BLM prescribed burning actions within non-attainment areas since the burning would: 1) not likely cause or contribute to new violations of Federal air quality standards; 2) would not increase the severity of existing violations for Federal and State air quality standards; or 3) would not delay the timely attainment of Federal air quality standards.

Affected Environment

Particulate Matter Emissions

Most broadcast-type prescribed burning (broadcast burning, under-burning, jackpot burning) occurs in spring and fall, when frequent cold fronts and short-wave troughs create atmospheric instability during the day. This instability promotes air mixing and transport of pollutants away from SSRAs and air quality non-attainment and maintenance areas. Most pile burning (hand piles, machine piles, landings) occurs in fall and winter, when the atmosphere is typically more stable, with a higher potential to affect air quality adversely for relatively short periods.

Large wildfires contribute to air quality issues over large areas and for prolonged periods. During 2002, wildfires resulted in 14 daily $PM_{2.5}$ exceedences in Klamath Falls and one in Medford (ODEQ 2003); at that time the daily $PM_{2.5}$ standard was 65 $\mu g/m^3$ (it has since been lowered) . Elevated particulate levels were reported between late July and the end of August at Bend, Brookings, Cave Junction, Grants Pass, Klamath Falls, and Medford (ODEQ 2003). Similar issues developed in 2008 from extensive wildfires burning in northern California; smoke from those fires reached as far north as Portland (ODEQ 2009).

ODF began estimating $PM_{2.5}$ emissions from wildfires as part of their annual smoke management reports beginning in 2002, although only a statewide accounting is available. Estimated wildfire $PM_{2.5}$ emissions commonly exceed 1000 tons per year and exceeded 6000 tons per year in 2006, 2007, and 2012. The 2012 fire season resulted in the highest estimated $PM_{2.5}$ emissions from wildfire at nearly 12,000 tons. However, most of these emissions were from the large rangeland wildfires in southeastern Oregon. Data for the 2013 fire season were not available; however, there were several large wildfires in southwestern Oregon in 2013 that likely contributed a significant amount of particulate pollution, and potentially created problematic surface ozone concentrations as well.

Based on ODF annual reports of tons consumed by prescribed burning in the Other Federal category from 1995 through 2012, actual emissions have averaged 840 tons (range 376 – 1,538 tons) of PM_{10} and 753 tons (range 337 – 1,378 tons) of $PM_{2.5}$ per year, primarily from hazardous fuels reduction treatments in southwest Oregon and slash disposal following forest management operations (**Figure 3-11**). These estimated emissions account for approximately 7.5 percent of total PM_{10} and $PM_{2.5}$ emissions from prescribed burning in western Oregon. The Other Federal category consists mostly of burning by BLM with only minor contributions from the National Park Service and U.S. Fish and Wildlife Service.

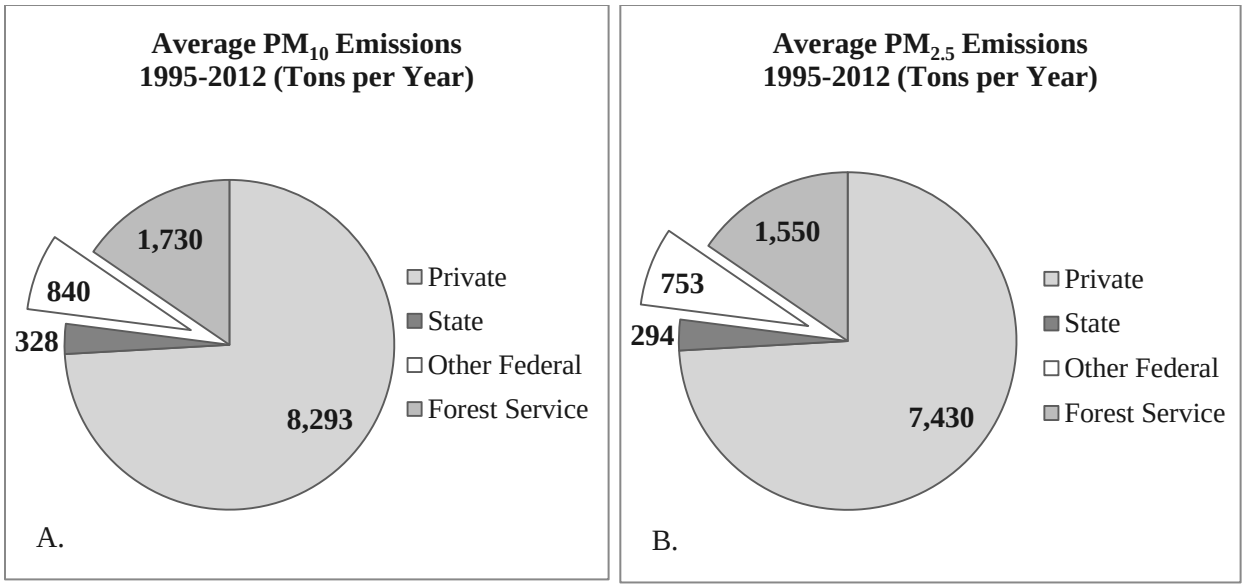


Figure 3-11. Estimated emissions from prescribed burning in western Oregon for A.) particulate matter 10 microns in size and smaller, and B.) particulate matter 2.5 microns in size and smaller.
BLM prescribed burning comprises most of the Other Federal category.

The Oregon Department of Environmental Quality (ODEQ) (2013a) reports that trends have been downward for most pollutants in most areas except for daily $PM_{2.5}$ in Klamath Falls and Oakridge. Both Klamath Falls and Oakridge have exceeded the daily $PM_{2.5}$ standard of 35 $\mu g/m^3$ nearly every year since 2006, when the standard was lowered to that level. Residential home heating in winter is associated with most exceedences of the $PM_{2.5}$ standard with summer wildfires a secondary factor. The EPA (2013) lowered the primary annual $PM_{2.5}$ standard to 12 $\mu g/m^3$, effective 18 March 2013. Whether this change will result in any areas designated as non-attainment for the annual $PM_{2.5}$ standard will not be known until 2015 at the earliest. The daily $PM_{2.5}$ standard remains unchanged.

Despite the best efforts of both ODF smoke forecasters and BLM personnel, intrusions into smoke sensitive receptor areas can and do occur. The occurrence of intrusions is not related to the number of acres burned in any given year (**Figure 3-12**), but, according to an evaluation of six smoke intrusion reports for 2008 and 2012, is most commonly a result of an unexpected shift in wind direction from the forecasted direction. Many of these shifts likely resulted from localized meteorological patterns, which could not be resolved with coarse-scale weather forecast models.

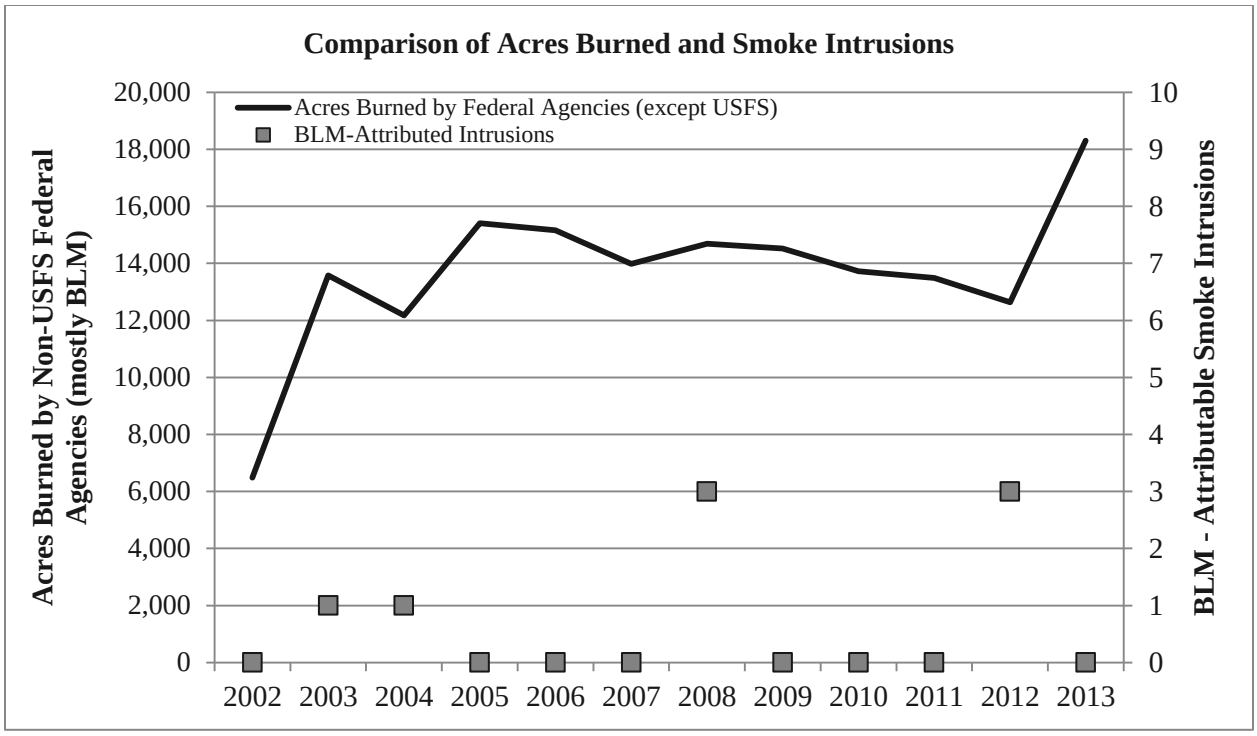


Figure 3-12. Number of smoke intrusions attributed to BLM prescribed fires into sensitive receptor areas compared to annual acres burned from 2002 through 2013 in western Oregon.
Nearly all intrusions were in southwest Oregon. Sources: ODF annual smoke reports 2002-2013, available at http://www.oregon.gov/odf/pages/fire/smp/smkmgtannualrpts.aspx.

Visibility and Air Quality

Of the four monitored mandatory Class 1 areas within or adjacent to the planning area, none meet the natural background conditions for haze for either the clearest or the haziest days, although Crater Lake National Park and Mount Hood Wilderness come the closest for the clearest days (**Table 3-15**). Visibility is generally improving at Crater Lake National Park and the Mount Hood and Kalmiopsis wildernesses, although not all trends are significant. Visibility at Three Sisters Wilderness is slowly degrading, although the trend is not significant yet.

Table 3-15. Visibility conditions and trends at four mandatory Class 1 areas within or adjacent to the planning area from 2003 through 2012. The main contributors to the haziest days are organic carbon and ammonium sulfate.

Parameter	Crater Lake National Park	Kalmiopsis Wilderness	Mount Hood Wilderness	Three Sisters Wilderness
Natural condition: clearest days	246 miles (0 deciviews)	~161 miles (~4 deciviews)	229 miles (1 deciview)	211 miles (2 deciviews)
Current condition: clearest days	>211 miles (<2 deciviews)	~143 miles (~ 6 deciviews)	211-229 miles (1-2 deciviews)	174-198 miles (2.5-3.5 deciviews)
Trend in clearest days	Significant downward	Non-significant downward	Significant downward	Non-significant upward
Natural condition: haziest days	~112 miles (~8 deciviews)	~90 miles (~9.5 deciviews)	~112 miles (~8 deciviews)	92 miles (9 deciviews)
Current condition: haziest days	40-87 miles (10-18 deciviews)	37-68 miles (13-19 deciviews)	47-81 miles (11-17 deciviews)	37-62 miles (13-18 deciviews)
Trends in haziest days	Non-significant downward	Significant downward	Non-significant downward	Non-significant upward

Source: IMPROVE website: http://vista.cira.colostate.edu/improve/. Accessed 18 November 2014

In 2013, ODEQ evaluated the contribution of prescribed fire to the 20 percent worst-case visibility days in Oregon's Class I areas, concluding that prescribed burning in close proximity to mandatory Class I areas was a significant contributor to the 20 percent worse days (ODEQ 2013b). The Kalmiopsis Wilderness and Crater Lake National Park were particularly affected, especially in October and November (**Figure 3-13**). As a result, ODF revised the Oregon Smoke Management Plan to require that any personnel conducting a prescribed fire within 31 miles (50 km) upwind of these two mandatory Class I areas follow a checklist of procedures designed to keep the main plume out of Crater Lake National Park or the Kalmiopsis Wilderness.

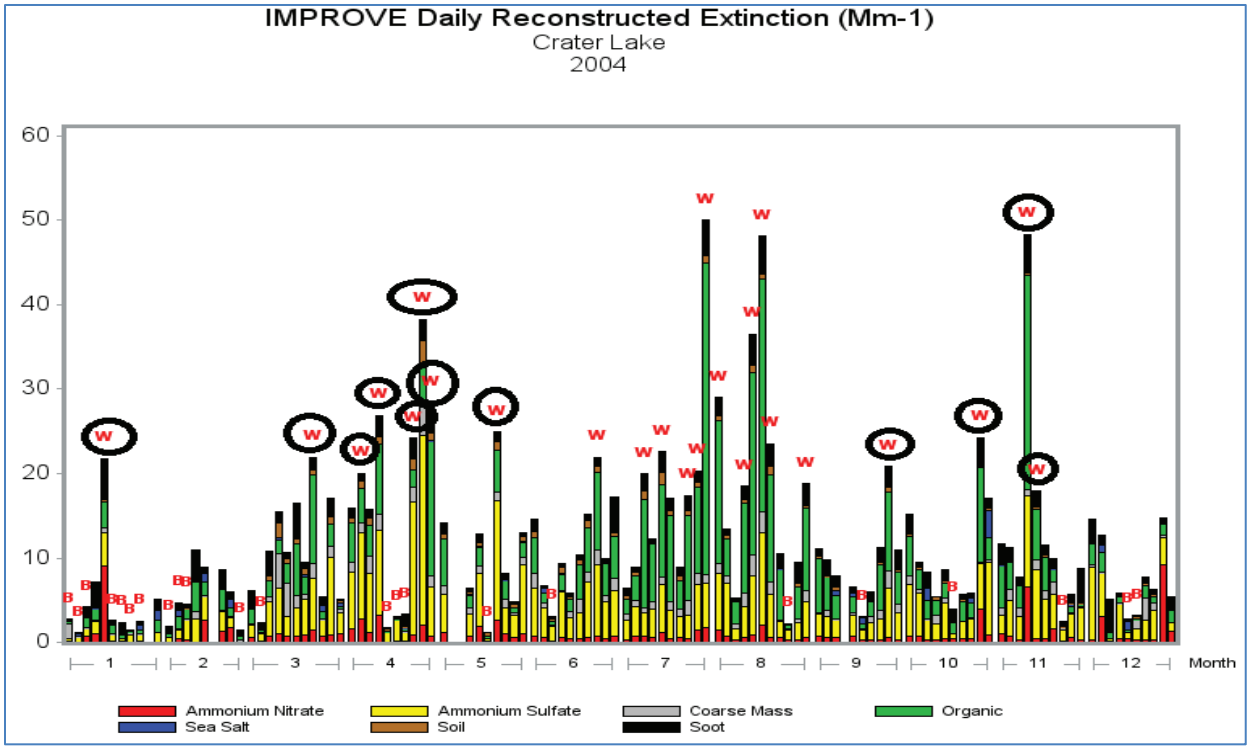


Figure 3-13. Example of identification of the 20 percent worse days in a given year and the proportional contribution of various factors to reduced visibility.
Black and green indicate vegetation burning as the source of the pollutant. "W" identifies a worse day and a circled "W" indicates prescribed fire as the probable cause. Source: ODEQ 2013b.

Adverse impacts to air quality that are caused by prescribed burning, including effects to visibility and human health, generally tend to be of short duration (hours) and limited to the local area. Conversely, wildfire adverse impacts tend to be of longer duration (days to weeks) and occur over a much broader area and produce much unhealthier conditions (**Figure 3-14**).

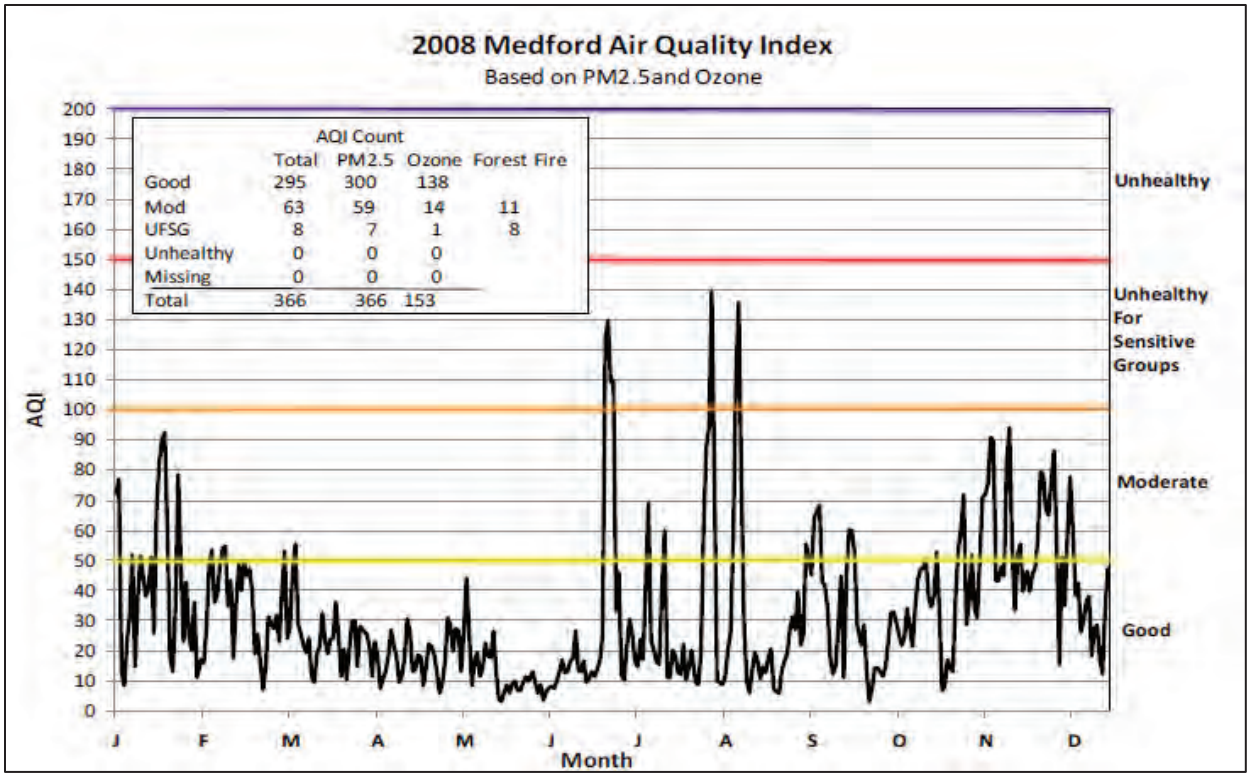


Figure 3-14. Daily air quality index for Medford in 2008.
Large spikes in July and August are from wildfires while moderate air quality in September through January is primarily woodstoves with some smoke from pile burning possible. Three intrusions attributed to BLM-prescribed burning into mandatory Class 1 areas did occur. Source: ODEQ 2009.

Air quality and visibility data from 2013 illustrate the impacts from wildfires. During that summer, wildfire impacts in southwest Oregon produced unhealthy or more severe levels for seven days in Medford (**Figure 3-15**) and for nine days in both Grants Pass and Cave Junction (**Figure 3-16**). It also resulted in severe degradation of visibility in Crater Lake National Park (**Figure 3-17**) and the Kalmiopsis Wilderness (data not shown).

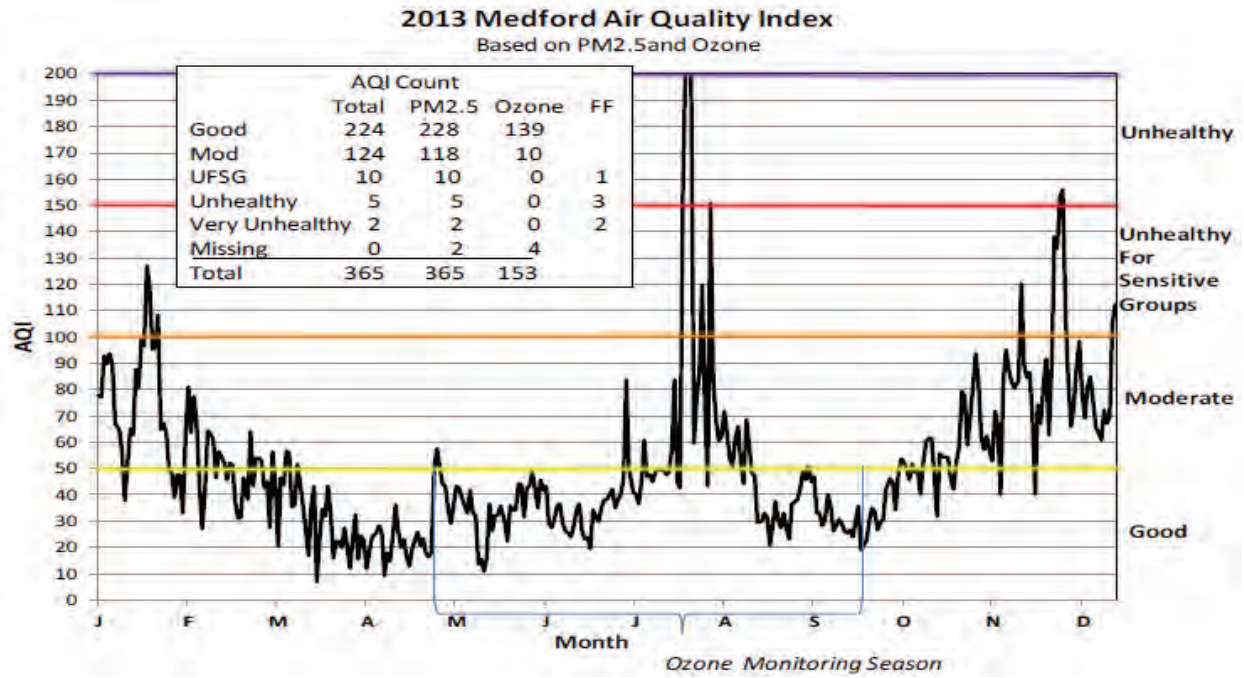


Figure 3-15. Air quality index for 2013 for Medford.
The large spike in late July was due to a series of wildfires, of which the Douglas Complex was the largest. "FF" refers to the days where air quality degradation was attributed to forest fires. Additional air quality degradation occurred from November through February from sources other than prescribed fire. Source: ODEQ 2014.

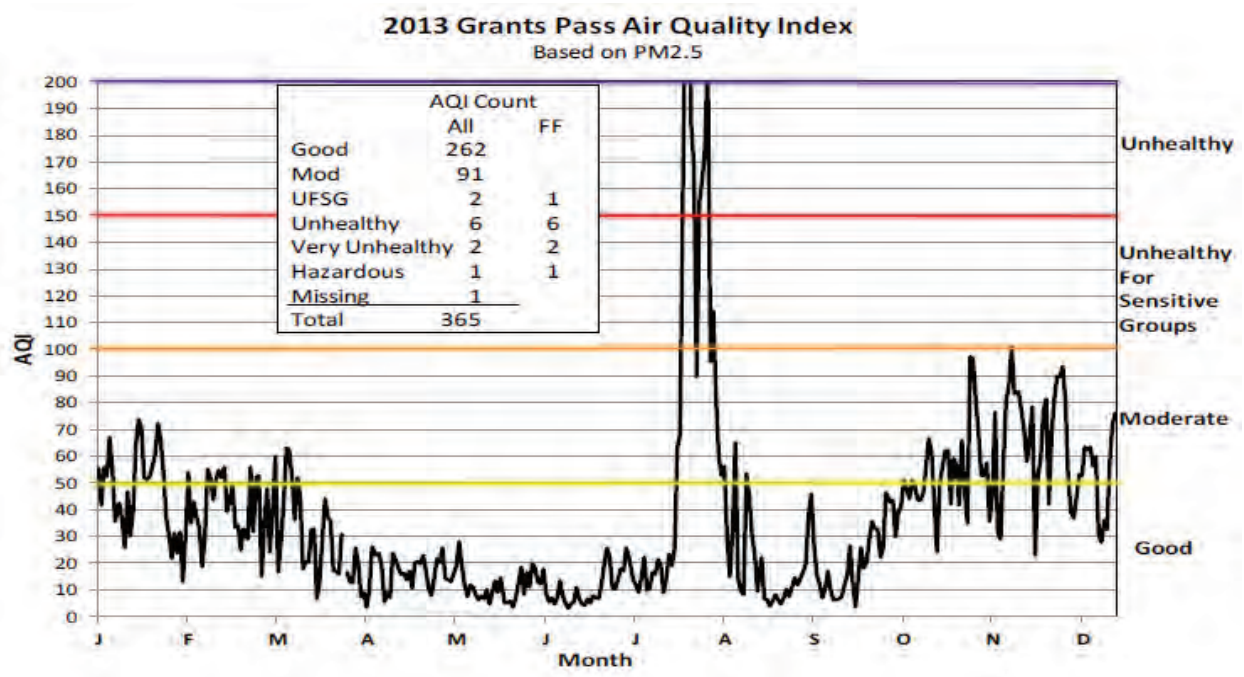


Figure 3-16. Air quality index for 2013 for Grants Pass.
The large spike in late July was due to a series of wildfires, of which Douglas Complex was the largest. "FF" refers to the days where air quality degradation was attributed to forest fires. Source: ODEQ 2014.

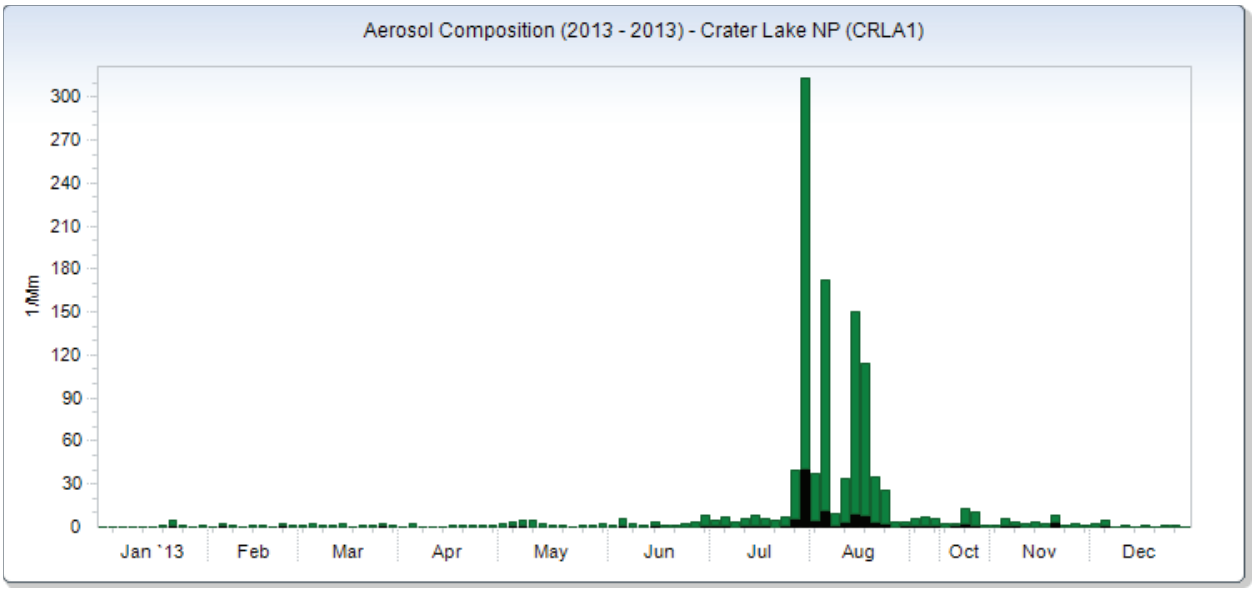


Figure 3-17. Degradation of visibility from burning vegetation in 2013 as measured through light scattering (inverse megameters) at Crater Lake National Park.
Wildfires typically create 5-10 times greater impacts than other types of events and over several weeks. Source: IMPROVE website, available at http://views.cira.colostate.edu/fed/DataWizard/Default.aspx , accessed 25 November 2014.

Environmental Effects

Particulate Matter Emissions

Since the hazardous fuels prescribed fire program does not vary between alternatives or over time, the expected emissions are constant. Estimated wildfire emissions vary over time, but not between alternatives. Therefore, the main variable in estimated particulate emissions is the amount of activity fuels prescribed burning both over time and between alternatives. Since fuel treatment levels are projected to increase under all alternatives, including the No Action alternative, relative to actual levels in the past, emissions of both PM_{10} and $PM_{2.5}$ are expected to increase relative to the 2013 baseline (**Figures 3-18 and 3-19**).

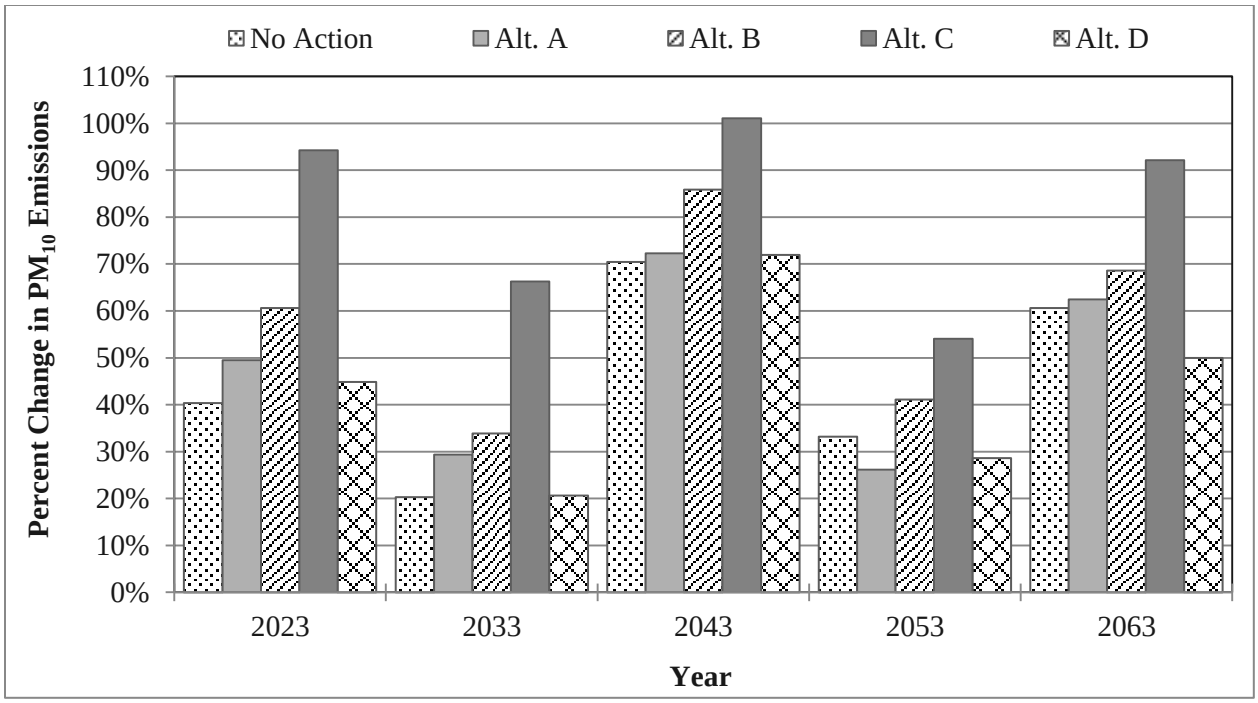


Figure 3-18. Expected increases in PM_{10} emissions from prescribed fire and wildfire over time and under each alternative relative to the estimate for current prescribed fires and wildfires.

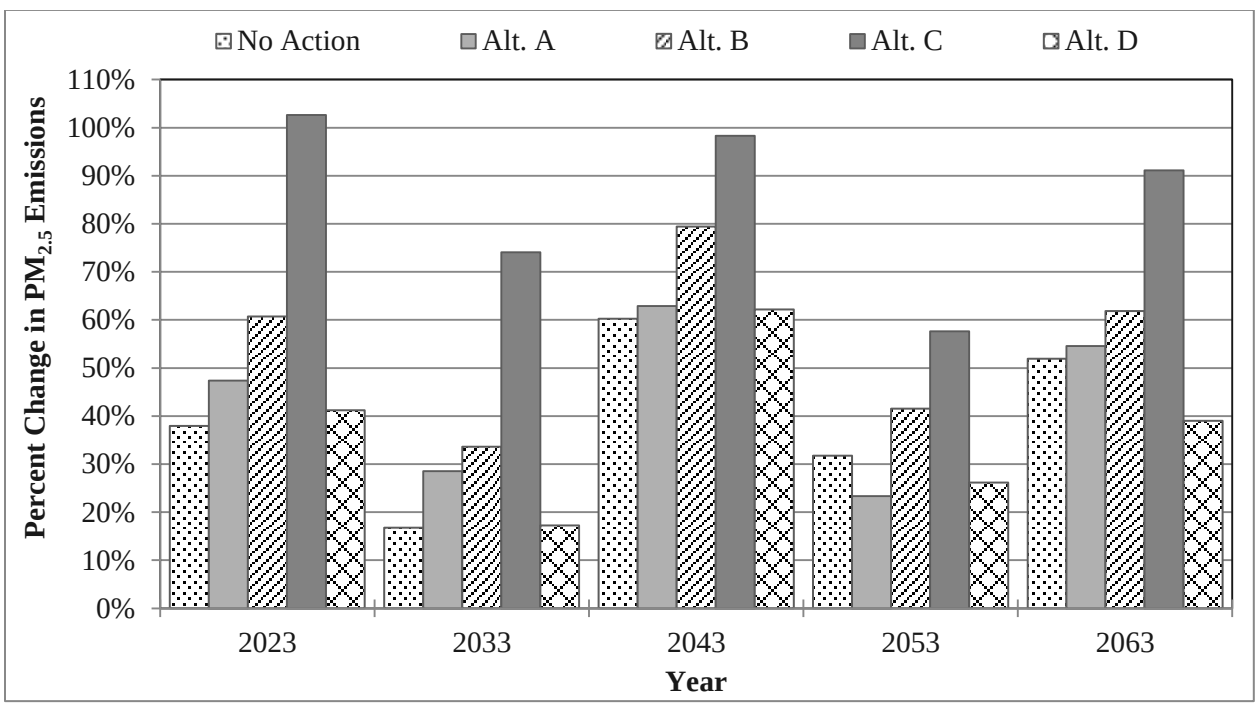


Figure 3-19. Expected increases in $PM_{2.5}$ emissions from prescribed fire and wildfire over time and under each alternative relative to the estimate for current prescribed fires and wildfires.

Some of the difference between the estimated current and projected emissions is likely due to the differing estimation methods used for each. Fuel treatment method (e.g., hand or machine pile burning,

broadcast burning) affects the amount of particulates emitted by affecting the amount of fuel consumed and the relative proportions of flaming and smoldering combustion (Hardy *et al*. 2001). Smoldering combustion emits more than twice the particulates as flaming combustion (Hardy *et al*. 2001). The current condition is based on the tons consumed reported to ODF, with insufficient information to determine the proportions of actual treatment methods. Thus, the current condition is based on a generic multiplier applied to the reported tons consumed. Whether this value represents an under-estimation or over-estimation of current conditions is not known. The projected emissions were based on more detailed information using more sophisticated tools than a generic multiplier.

Similar to the current condition, the Medford District is projected to have the largest number of acres burned by wildfire, followed by the Roseburg District and then the Eugene and Salem Districts, with much smaller acres projected to burn over time on the Coos Bay District and the Klamath Falls Field Office. Since the projected hazardous fuels program is the same as the current program, the Medford District would continue to have the largest hazardous fuel program, followed by the Klamath Falls Field Office and then the Roseburg District. The Coos Bay District would have a small hazardous fuels program while The Eugene and Salem Districts essentially would have no hazardous fuels program. In contrast, which district has the largest activity fuels program varies by alternative.

Under all alternatives, including the No Action alternative, the Medford District would produce the most emissions from prescribed burning (**Figure 3-20**), with the highest emissions under Alternative B and lowest under Alternative A. Emissions under the No Action alternative and Alternative D would be similar. The Roseburg District would produce its highest emissions under Alternative C and lowest under Alternative A. Between these two districts, in combination with expected emissions from wildfire, the greatest potential impacts to air quality in the planning area would occur in the Rogue River and Umpqua River valleys and their associated smoke sensitive areas, along with the Kalmiopsis Wilderness and Crater Lake National Park. Much of the activity for natural fuels burning consists of pile burning, which typically occurs in fall and winter. In fall, atmospheric instability and relatively frequent storms tends to limit smoke impacts during the day, but areas down drainage from burn locations could experience smoke effects at night. Inversions in winter could result in prescribed fire smoke mingling with woodstove smoke to adversely affect air quality (e.g., **Figure 3-15**), although compliance with the smoke management plan usually limits degradation of air quality.

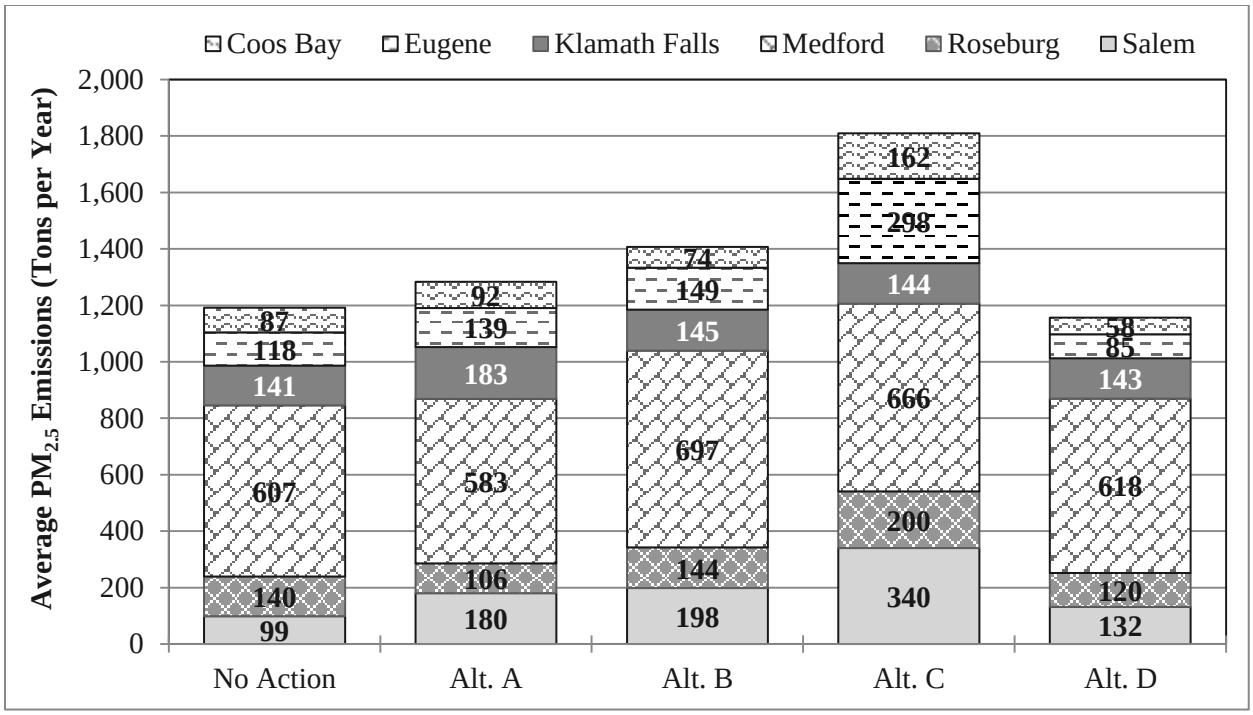


Figure 3-20. Average annual $PM_{2.5}$ emissions from prescribed burning over the 50-year analysis period by district or field office and alternative.

The Klamath Falls Field Office would produce its highest emissions under Alternative A with no difference in emissions under the No Action alternative and Alternatives B through D (**Figure 3-20**). Potential effects to the Klamath Falls Field Office non-attainment area likely would not differ from those currently experienced. Similarly, emissions from the Coos Bay District would change little from present emissions under all alternatives.

Emissions from the Eugene and Salem Districts would increase under all alternatives, except for Alternative D in the Eugene District, relative to the current condition, with the biggest increases under Alternative C (**Figure 3-20**). As a result, the probability of adverse impacts to smoke sensitive receptor areas in the Willamette Valley would increase, likely due to unexpected wind shifts, although the overall probability would remain low. Increased burning on the Eugene District may result in additional adverse impacts to air quality in Oakridge, although the combined effects of the location of BLM-administered parcels relative to Oakridge, compliance with the smoke management plan, terrain, and the timing of burns relative to the timing of the worst air quality in Oakridge would keep the probability of such effects very low.

Visibility and Air Quality

Continued adherence to the smoke management plan is expected to limit adverse effects to visibility and air quality across all alternatives, although some issues are likely to remain in southwest Oregon where the efficacy of the new requirements as of 2014 have not yet been established. The increased amount of prescribed burning, particularly under Alternative C, may increase the risk of additional smoke intrusions into mandatory Class I areas, although past intrusions have not been correlated with the number of acres burned. At present, there are no factors that provide a clear indication that the increased prescribed burning under the action alternatives would result in additional effects on visibility and air quality from smoke intrusions as compared to the observed past.

The relative proportion of the landscape under some degree of active management can influence subsequent wildfires and the potential to affect human health and visibility adversely in summer. Active management, particularly where a primary objective is to alter fire risks, can reduce the potential for adverse impacts to human health and visibility from wildfires by increasing landscape diversity in terms of the mix of stand sizes, age classes, structure, and species compositions. Landscape heterogeneity tends to create burn pattern heterogeneity and can reduce the potential for large, homogeneous stand-replacing patches and long-term smoldering within large wildfires, especially in landscapes with active fire regimes (e.g., Mitchell *et al*. 2009, Miller *et al*. 2012, Loudermilk *et al*. 2014, Volkova *et al*. 2014). Less active management under the 1995 RMPs has tended to create more homogeneous landscapes, particularly with respect to stand structure, promoting larger patches of similar burn severity, longer-term smoldering, and resulting emissions.

The number of acres receiving active management indicates the potential to reduce adverse effects from wildfires over time. How much area would need to be treated before such an effect occurred is not known, but likely would take two or more decades of increased land management activity to begin to become apparent. **Table 3-16** depicts a relative rating for each alternative for each district within the planning area using land allocation as a basis for identifying the amount of area expected to receive some degree of active management. Administrative reserves, Congressional reserves, Late-successional Reserves where the primary approach is protection and the inner, no-cut areas of Riparian Reserves are assumed to have little to no active management.

Table 3-16. Relative risk to human health and visibility by alternative based on the estimated acres expected to receive some degree of active management. The highest risk is 5, the lowest risk is 1, and a tie between two alternatives is x.5.

District	No Action	Alt. A	Alt. B	Alt. C	Alt. D
Coos Bay	5	2.5	2.5	1	4
Eugene	5	2	3.5	1	3.5
Medford	4.5	4.5	2	1	3
Roseburg	5	2	3.5	1	3.5
Salem	5	2	3	1	4
Means	**5**	**3**	**3**	**1**	**4**

A high proportion of the Klamath Falls Field Office (over 80 percent) would be available for active management due to the high number of acres in the eastside management area, so it was not rated. Risks to human health and visibility from wildfires likely would not differ from current conditions. On all other districts, the No Action alternative would have the lowest number of acres under active management. Current trends towards forest homogenization would continue, increasing the risk of large wildfires, large, homogeneous burn patches, and prolonged smoldering. Those factors, in turn, are expected to increase the risks to human health and visibility from wildfires over time.

Alternative C would have the most area under active management on each office, so would have the highest potential to create sufficient landscape heterogeneity and lower risks to human health and visibility over time. Alternative C also includes a large amount of clear-cutting, which can create landscape homogeneity although it does not necessarily follow that it will. Harvest levels would remain below that of the 1980s and a greater diversity of general harvest prescriptions would occur. Whether the amount of active management would generally have a larger influence than the amount of clear-cutting on wildfire burn patterns, would depend on the distribution and sizes of clearcut patches and subsequent management of the next stand, particularly in relation to adjoining private forestlands.

The potential risk of adverse effects under alternatives A, B, and D depend more on the BLM office in question. As such, no other alternative clearly stands out in its potential to reduce the potential risks to human health and visibility from wildfires. Overall, alternatives A and B would result in similar effects over the planning area as a whole, with some reduced risks relative to No Action and Alternative D, but greater risks relative to Alternative C. In the Medford and Roseburg Districts, the two with the most active fire regimes, the order of potential risk reduction from greatest to least would be Alternative C, Alternative B, Alternatives A and D, and the No Action alternative.

Climate Change

Over time, climate change may result in a reversal of the trend in visibility and a worsening of air quality in summer and fall. Many climate projections foresee longer fire seasons and more severe burning conditions, which would lead to more acres burned, increased fire severity (e.g., Mote *et al*. 2014 and references therein), and greater particulate production over the life of such wildfires. One result would be an increase in the number of unhealthy days and reduced visibility in mandatory Class 1 areas. In addition, as the atmosphere warms, it holds more moisture; an increasing trend in relative humidity has already been documented in the United States (Walsh *et al*. 2014 and references therein). Certain pollutants are very responsive to even small increases in relative humidity, potentially degrading visibility with no change in pollutant level (Hand *et al*. 2011).

References

EPA. 2013. 40 CFR 50-53, 58: National ambient air quality standards for particulate matter, Final Rule. Federal Register **78**: 3085-3287.

Hand, J. L., S. A. Copeland, D. E. Day, A. M. Dillner, H. Indresand, W. C. Malm, C. E. McDade, C. T. Moore, M. L. Pitchford, B. A. Schichtel, and J. G. Watson. 2011. Spatial and seasonal patterns and temporal variability of haze and its constituents in the United States: report V. Colorado State University, Cooperative Institute for Research in the Atmosphere, Fort Collins, CO.

Hardy, C. C., R. D. Ottmar, J. L. Peterson, J. E. Core, and P. Seamon, editors. 2001. Smoke managament guide for prescribed and wildland fire 2001 edition. National Wildfire Coordination Group, Boise, ID.

Loudermilk, E. L., A. Stanton, R. M. Scheller, T. E. Dilts, P. J. Weisberg, C. Skinner, and J. Yang. 2014. Effectiveness of fuel treatments for mitigating wildfire risk and sequestering forest carbon: A case study in the Lake Tahoe Basin. Forest Ecology and Management **323**: 114-125.

Miller, J. D., C. N. Skinner, H. D. Safford, E. E. Knapp, and C. M. Ramirez. 2012. Trends and causes of severity, size, and number of fires in northwestern California, USA. Ecological Applications **22**: 184-203.

Mitchell, S. R., M. E. Harmon, and K. E. B. O'Connell. 2009. Forest Fuel Reduction Alters Fire Severity and Long-Term Carbon Storage in Three Pacific Northwest Ecosystems. Ecological Applications **19**: 643-655.

Mote, P. W., A. K. Snover, S. Capalbo, S. D. Eigenbrode, P. Glick, J. S. Littell, R. Raymondi, and S. Reeder. 2014. Chapter 21: Northwest. Pages 487-513 in J. M. Melillo, T. T. C. Richmond, and G. W. Yohe, editors. Climate change impacts in the United States: the third national climate assessment. U.S. Global Change Research Program, Washington, D.C.

ODEQ. 2003. 2002 Oregon air quality data summaries. ODEQ Air Quality Division, Portland, OR.

---. 2009. 2008 Oregon air quality data summaries. Portland, OR.

---. 2012. 2011 Oregon air quality data summaries. Portland, OR.

---. 2013a. 2012 Oregon air quality data summaries. Portland, OR.

---. 2013b. Evaluation of prescribed fire contribution to Oregon Class I area 20% WD impacts. Portland, OR.

---. 2014. 2013 Oregon air quality data summaries. Portland, OR.

USDI BLM. 2014. Resource management plans for western Oregon planning criteria. Bureau of Land Management, Oregon/Washington State Office, Portland, OR. http://www.blm.gov/or/plans/rmpswesternoregon/plandocs.php.

Volkova, L., C. P. Meyer, S. Murphy, T. Fairman, F. Reisen, and C. Weston. 2014. Fuel reduction burning mitigates wildfire effects on forest carbon and greenhouse gas emission. International Journal of Wildland Fire **23**: 771-780.

Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. C. Doney, R. A. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville. 2014. Chapter 2: Our changing climate. pp. 19-67 in J. M. Melillo, T. T. C. Richmond, and G. W. Yohe, editors. Climate change impacts in the United States: the third national climate assessment. U.S. Global Change Research Program, Washington, D.C.