Climate Change

Increasingly, the relationships between human-caused emissions, climate change, and the role of the forests as carbon sinks (carbon sequesters) are being documented (IPCC 2007, USEPA 2013, USGCRP 2014); it is generally agreed that human activities are now the dominant agents of climate change (USGCRP 2014, page 736). Scientific understanding of observed temperature changes in the United States has improved; the latest estimates are that average temperatures in the United States are expected to increase by about 4.4 degrees centigrade if current greenhouse gas emissions continue and by about 1.4 degrees centigrade if immediate and rapid greenhouse gas reductions occur (USGCRP 2014, chapter 2, figure 7). Trends in heat waves, drought and fire risk are increasing in many regions as temperatures and evaporation rates rise (USDA Forest Service 2011, USGCRP 2014, pages 736 and 769-772); these trends have affected and are likely to continue to affect the Westside Fire Recovery project area.

Although climate change simulations vary in making future predictions of climate change in regard to projected precipitation, in most observations precipitation events have become more extreme (USGCRP 2014, page 770, figure 32). Most precipitation in the western United States has been occurring, and is projected to continue to occur, during winter storms. However, increased winter temperatures in California may mean that more of the winter precipitation falls as rain and less as snow. Snow accumulations may decrease, as was observed in the project area in 2014 and 2015; spring snow melt is projected to occur earlier than in the past. These findings are likely to increase the likelihood of continued drought and risk of wildfire.

Although there is little local scientific information to help predict whether or not storms may increase in size or frequency, since 1964 there have been major channel-altering events about once per decade in the Klamath Mountains (Cover et al. 2010). There is national evidence that storms are more extreme than in the past (USGCRP 2014); if these trends are indicative of what will happen locally, extreme storm events may occur in the project area in the future.

The use of future climate scenarios and ecological models suggests that the impact of climate change on ecosystems in the United States may include increases in ecosystem productivity in the short term and shifts in the distribution of plants and animals in the long term (Joyce and Birdsey 2000, Anderson and Palik 2011). Although there is no local scientific information to predict what changes will occur in the project area, there is an opportunity with this project for some adaptation to climate change effects on the local level.

Adapting to climate change and its potential impacts poses challenges and opportunities to managing resources. Forests and rangelands are seen as part of the solution to reducing atmospheric carbon dioxide and other greenhouse gases due to their ability to sequester or store carbon (USEPA 2013). Forest ecosystems and the associated wood products industry currently serve as a “carbon sink,” offsetting about 16% of carbon dioxide emitted by fossil fuel burning in the United States in 2011 (USGCRP 2014, page 176). Climate change, combined with current societal trends in land use, is projected to reduce this rate of forest carbon uptake (USGCRP,

page 179) but forest management practices that increase forested areas (planting or encouraging growth of forests) have the potential to increase carbon sinks (USGCRP, page 181).

Some uncertainty continues to exist in quantifying the impact of project-level emissions on climate (CEQ 2014). Although down-scaling techniques are in use to assess global climate change impacts at regional levels, there are uncertainties in these approaches especially in applying them to the project level. Projecting climate change impacts at the local level is a resource intensive approach with methodological limitations (USGCRP 2014, page 761). Local information concerning precipitation and temperature in the vicinity of the Westside Fire Recovery project suggests that national predictions on increasing temperature and erratic precipitation trends may be reflected at the project level (Butz and Safford 2011). Specifically, the following may occur:

- Increases in average temperatures, with earlier snowmelt, may lead to an increase in the size and frequency of wildfires with warmer, drier and longer fire seasons as was evident in 2014.
- Harvest of burned areas can reduce fuels, especially those larger fuels that are slow to ignite but burn at high intensities which lead to heated soils and damaged soil productivity.
- From our current state of understanding, climate change may bring about increases in insect and pathogen outbreaks.

Based on regional predictions of a warming climate and increases in disturbances such as wildfire and insect infestations, it is expected that treatments proposed in the action alternatives for this project will benefit forests through harvest of dead or dying trees, fuel-reduction treatments and planting designed to promote species diversity, favor fire-resistant tree species, and reduce risk of loss due to wildfire. Some adaptation measures such as assisted migration of vegetative and animal species are not proposed due to both difficulty in anticipating climate-related changes at local scales (USGCRP 2014, page 671) and lack of knowledge about the impacts to the species and ecosystem from such migration (Millar 2007).

The contribution of this project to factors that may affect climate change such as greenhouse gas emissions is disclosed in the Air Quality section of this chapter and referenced Air Quality resource report. Knowledge about how to effectively manage forests for carbon sequestration is evolving; active forest management is believed to be an effective method of long-term carbon sequestration (IPCC 2007, USGCRP 2014, USDA Forest Service 2011, page 23). Although there is some controversy about whether older trees are more successful in storing carbon than younger trees (Coulson et al. 2015), there is general agreement that forests are an important factor in carbon storage (Fitzsimmons, et al. 2004, US EPA 2013, Pan et al. 2011). Likewise, there is general agreement that less carbon is stored in decaying wood than in wood content in lumber and manufactured wood products (Skog 2008, Finkral and Evans 2008) and that stand-replacing wildfire releases carbon into the atmosphere (Vose et al. 2012).

Although there are models to calculate carbon storage for forests, using these models for this project does not seem to be cost-efficient since this project will remove very few live trees and have little direct effect on carbon storage. Selecting trees for reforestation that are likely to survive if climate change predictions are fulfilled in the project area is included in the discussion of site preparation and planting in Chapter 2 and in the Vegetation section of this chapter. Harvest, fuel breaks and additional fuel-reduction treatments will not eliminate wildfire from the project area but can help change fire behavior (as discussed in the Fire and Fuels section of this chapter and Fire and Fuels resource report) thereby likely reducing carbon dioxide emissions resulting from wildfire. Short-term negative effects on carbon storage from prescribed burning are balanced by long-term carbon storage negative effects from wildfire. Repairing legacy sediment sites with structures that can withstand larger flood events (as discussed in chapter 2) will help adapt to more extreme and erratic storms; regular maintenance will also include adaptation to future storms. Effects on future global climate change from this project are too small to measure but mitigation and adaptation techniques (USGCRP, chapters 27 and 28) are expected to be beneficial.