2010 Revised
Ice Timber Sale
And
Fuels Reduction Project
Fuels and Air Quality
Supplemental Information Report

Prepared by: /s/ Nickie Washington
Nickie Washington, District Fuels Specialist
Kern River Ranger District, Sequoia National Forest

Prepared by: /s/ Scott Williams
Scott Williams, Fire Management Specialist
USDA Forest Service
Adaptive Management Services Enterprise Team

January 27, 2011
Table of Contents

Introduction .............................................................................................................................................. 4
Regulatory Direction ............................................................................................................................... 4
  Sierra Nevada Forest Plan Amendment .............................................................................................. 4
Methodology for Analysis ....................................................................................................................... 6
Affected Environment ............................................................................................................................ 7
  Existing Condition ............................................................................................................................... 7
Environmental Consequences ................................................................................................................ 8
  Alternative A - No Action ..................................................................................................................... 8
  Alternative B - Proposed Action .......................................................................................................... 9
  Alternative C - No Commercial Thin ................................................................................................. 11
Air Quality ............................................................................................................................................. 13
  Green House Gases and Climate Change ........................................................................................... 14
Recommendations .................................................................................................................................. 18
References .............................................................................................................................................. 19

Appendix A – Methodology – Separate Document

Appendix B – FFE-FVS Runs – Separate Document

Appendix C – Fuels Reduction Activities That Have Taken Place on Private or Public Lands in the Project Area within the Past Decade – Separate Document
Introduction

This report is a supplemental information report (SIR) to the 1998 Revised Ice Timber Sale & Fuel Reduction Project Fire & Fuels Report. It analyzes new information based on stand exam plots taken September 2009 and the validity of the 1998 Revised Ice Timber Sale & Fuel Reduction Project Fire & Fuels Report using the Fire and Fuels Extension (FFE) to the Forest Vegetation Simulator (FVS) computer modeling program. The report outlines current regulatory direction, which guides the development of management activities and the issues addressed. It discusses the methodology of analysis, summarizes the existing, and addresses the direct, indirect, and cumulative effects of No Action Alternative A, the Proposed Action Alternative B, and the No Commercial Thin Alternative C relating to fire and fuels management.

NOTE: 358 acres of commercial thinning on the helicopter logging and pile burning (associated with the helicopter logging) have been completed from the 1998 Revised Ice Timber Sale & Fuel Reduction Project. In 2008 and 2009 trees less than 10 inches dbh were hand thinned, piled and burned along road ways, near structures and in helicopter units 11, 15, 16 and in tractor unit 14. Units 11, 15, and 16 were underburned in fall of 2010. No commercial thinning or prescribed underburning has occurred on tractor unit 14.

Regulatory Direction

The Proposed Action Alternative B and the No Commercial Thin Alternative C proposes to treat activity fuels to levels that meet Sequoia LRMP Standards and Guidelines 1988. This would require the establishment of fire protection features that assure control of 98% of fires escaping initial attack (greater than 5 acres) at less than 50 acres and activity fuels treated to assure control of 90 percent of all fires at less than five acres (Sequoia LRMP 4-39). This report will evaluate if activities proposed meet current regulatory direction.

Sierra Nevada Forest Plan Amendment

Standards and guides for fuels management can be found in the Sequoia National Forest Land and Resource Management Plan (Forest Plan), as amended by the Sierra Nevada Forest Plan Amendment (SNFPA 2004). Table 1 lists the various fuels and fire standards and guidelines from the SNFPA 2004 that could apply to this project. The fuel treatments are designed to meet or move towards these standards and guidelines.

Table 1. Forest Plan Standards & Guidelines Relevant to Fire & Fuels Management

<table>
<thead>
<tr>
<th>Fire and Fuels Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 --- Reduce the size and severity of wildfire (ROD 49).</td>
</tr>
<tr>
<td>#2 --- Site-specific prescriptions should be designed to reduce fire intensity, rate of fire spread, crown fire potential, mortality in dominant and co-dominant trees, and tree density (ROD 49).</td>
</tr>
<tr>
<td>#4 --- Design mechanical treatments in brush and shrub to achieve the following standards within the treatment areas using 90th percentile fire weather conditions (ROD 50):</td>
</tr>
<tr>
<td>An average of 4-foot flame length.</td>
</tr>
<tr>
<td>Fireline production rates would be doubled.</td>
</tr>
<tr>
<td>Treatments should be effective for more than 5 to 10 years.</td>
</tr>
<tr>
<td>#5 --- Design a sequence of fuel reduction treatments in conifer forest types (including 3x plantation types) to achieve the following standards within the treatment area under 90th percentile fire weather conditions (ROD 50):</td>
</tr>
<tr>
<td>An average of 4-foot flame length.</td>
</tr>
<tr>
<td>Remove surface and ladder fuels to meet design criteria of less than 20% mortality.</td>
</tr>
<tr>
<td>Thin tree crowns to meet less than 20% probability on initiation of crown fire.</td>
</tr>
</tbody>
</table>

Mechanical Thinning Treatments
| #6 | Retain all live conifers 30 inches dbh or larger (ROD 50). |
| #7 | For mechanical treatments in mature forest habitat outside WUI defense zones (ROD 50):  
• Retain a least 40% basal area.  
• Retain 5% or more of trees 6 to 24 inches dbh.  
• Avoid reducing pre-existing canopy cover by more than 30%.  

### Snags & Down Woody Debris

| #10 | Determine down woody material retention levels on an individual project basis, based on desired conditions. Emphasize retention of wood in the largest size classes and in decay classes 1, 2, and 3. Consider the effects of follow-up prescribed fire in achieving desired down woody material retention levels (ROD 51). |
| #15 | Use the best available information for identifying dead and dying trees for salvage purposes as developed by the Pacific Southwest Region Forest Health Protection Staff (ROD 52). |
| #21 | Retain all blue oak and valley oak trees except: (1) stand restoration strategies call for tree removal; (2) trees are lost to fire; or (3) where tree removal is needed for public health and safety (ROD 53). |
| #23 | During mechanical vegetation treatments, prescribed fire, and salvage operations, retain all large hardwoods on the Westside except where: (1) large trees pose an immediate threat to human life or property (ROD 53). |

### California Spotted Owl & Northern Goshawk Protected Activity Centers (PACs)

| #7 | Design mechanical thinning treatments in home range core areas to retain 50% of canopy cover...within PACS remove only material needed to meet project fuels objectives (ROD 51). |
| #73 | While mechanical treatments may be conducted in protected activity centers (PACs) located in WUI defense zones and, in some cases, threat zones, they are prohibited within a 500-foot radius buffer around a spotted owl activity center within the designated PAC. Prescribed burning is allowed within the 500-foot radius buffer. Hand treatments, including handheld construction, tree pruning, and cutting of small trees (less than 6 inches dbh), may be conducted prior to burning as needed to protect important elements of owl habitat. Treatments in the remainder of the PAC use the forest-wide standards and guidelines for mechanical thinning (ROD p. 60). |
| #75 | For California spotted owls PACs, maintain a LOP, prohibit vegetation treatments within ¼ mile of activity center from March 1 through August 31 (ROD 60). |
| #76 | For northern goshawk PACs, maintain a limited a LOP, prohibit vegetation treatments within ¼ mile of nest site from February 15 through September 15 (ROD 60). |

### Riparian Conservation Areas (RCAs) and Critical Aquatic Refuges (CARs)

| #99 | Prohibit storage of fuels and other toxic materials within RCAs and CARs except at designated administrative sites and sites covered by a Special Use Authorization. Prohibit refueling within RCAs and CARs unless there are on other alternatives. Ensure that spill plans are reviewed and up-to-date (RCO #1 --- ROD 63). |
| #101 | Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water drafting sites to avoid adverse effect to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features (RCO #2 --- ROD 63). |
| #109 | Within CARs, in occupied habitat or “essential habitat” as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used (RCO #4 --- ROD 64). |
| #110 | Use screening devices for water drafting pumps. (Fire suppression activities are exempt during initial attack.) Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats (RCO #4 --- ROD 64). |
| #111 | Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include, or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community (RCO #4 --- ROD 64). |
Methodology for Analysis

The analysis area is the 743 acres of tractor logging. Ladder fuel reduction is proposed on 427 acres within the 743 acres of tractor logging in both Alternative B and C. Fuel loading (tons/acre) for the project area were estimated using “Photo Series for Quantifying Natural Forest Residues: Southern Cascades, Northern Sierra Nevada (PSW-56 Oct. 1981, Kenneth S. Blonski, John L. Schramel). Northern Forest Fire Laboratory (NFFL) Fuel Models were used for the surface fuel model themes expressed as outputs in the FFE-FVS runs (refer to Appendix A for those descriptions).

Fire and Fuels Extension to the Forest Vegetation Simulator (FFE-FVS)

FFE-FVS runs were conducted for the No Action Alternative A, Proposed Action Alternative B and No Commercial Thin Alternative C at existing condition, post treatment, 10 and 20 years. The FFE-FVS analyzes the effectiveness of proposed fire and fuel management treatments and potential fire effects on short- and long-term stand dynamics. 2009 stand exams, Wofford Remote Area Weather Sensor (RAWS) 90th percentile weather derived from Fire Family Plus computer program, and the fire weather prescription based on the Ice Burn Plan were used for the prescribed underburning treatments. Refer to Appendices A and B for further explanation and FFE-FVS runs.

Threshold Limits

Threshold limits are defined in this document to be the point at which fire behavior characteristics become undesirable. By not exceeding these limits, the predicted fire behavior is generally favorable for direct attack on all portions of a wildfire. This would result in a safer fire environment for firefighters or members of the public that may need to escape a future fire in or adjacent to the project area. The management of future wildfires would have a higher probability of success when the fire behavior does not exceed the threshold limits. Refer to Appendix B for further details on threshold limits. See Table 1 below for the threshold limits used in this report.

### Table 1. Fire behavior characteristics thresholds

<table>
<thead>
<tr>
<th>Fire Behavior Characteristics</th>
<th>Description</th>
<th>Threshold Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame Length</td>
<td>The average distance from the base of the flame to the tip.</td>
<td>4 feet</td>
</tr>
<tr>
<td>Rate of Spread</td>
<td>The speed the fire spread measured in chains per hour. 1 chain = 66 feet and 80 chains = 1 mile.</td>
<td>5 chains/hour</td>
</tr>
</tbody>
</table>

Under standards and guidelines fuel reduction treatments in conifer forest types should meet or bring treatments closer to an average of a 4-foot flame length under 90th percentile fire weather conditions. Table 2 compares flame length with fire suppression difficulty.

### Table 2. Flame length compared with fire suppression difficulty

<table>
<thead>
<tr>
<th>Fireline Intensity</th>
<th>Flame length</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>&lt; 4 feet</td>
<td>Direct attack at head and flanks with persons using hand tools. Hand line should stop fire spread.</td>
</tr>
<tr>
<td>Low-Moderate</td>
<td>4-8 feet</td>
<td>Employment of engines, dozers, and aircraft needed for direct attack, too intense for persons with hand tools. Hand line cannot be relied on to hold fire.</td>
</tr>
<tr>
<td>Moderate</td>
<td>8-11 feet</td>
<td>Control problems, torching, crowing, spotting; control efforts at the head are likely ineffective.</td>
</tr>
<tr>
<td>High</td>
<td>&gt; 11 feet</td>
<td>Crowning, spotting, and major fire runs are probable. Control efforts at the head or fire are ineffective.</td>
</tr>
</tbody>
</table>
In addition, fuel reduction treatments should meet less than 20% probability on initiation of crown fire (expressed in the probability of torching) and less than 20% mortality (expressed in the tree dbh size over 10 inches) during a wildland fire under 90th percentile fire weather conditions.

Fire Term Definitions (NWCG, 2004)

Type of fire:
- **Surface** - fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation.
- **Passive** - a fire in the crowns of trees in which trees or groups of trees torch, ignited by the passing front of the fire.
- **Active** - a fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.

*Canopy base height* – the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy.

*Chain* - unit of measure in land survey, equal to 66 feet (80 chains equal 1 mile).

*Crown index* – the 20-foot wind speed (measured 20 feet above forest canopy) at which active crown fire is possible.

*Flame length* – the distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), an indicator of fire intensity.

*Rate of spread* – the speed with which a fire moves in a horizontal direction across the landscape, usually expressed in chains per hour or feet per minute.

*Torching* – the burning of the foliage of a single tree or a small group of trees, from the bottom up.

*Torching index* – the 20-foot wind speed (measured 20 feet above forest canopy) at which some kind of crown fire (passive or active) is expected.

Limitations of the Models

Fire models are tools to help depict relative change in fire behavior and growth across the landscape. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the alternatives, rather as an indicator of absolute effects (Stratton 2006). Interpretation, professional judgment, experience, and local knowledge of fire behavior were used to evaluate the outputs from models. Be mindful that a model is a decision support tool, not a tool that makes decisions.

Affected Environment

Existing Condition

Existing conditions within the untreated units are similar to those of 1998 Fire & Fuels Report. However, 2009 stand exams indicate existing down fuel loadings to average 23 tons per acre as opposed to the 30 tons per acre cited in the 1998 Fire and Fuels Report. Pockets of fuel in excess of 100 tons per acre exist but are not represented in the 2009 stand exams. Differences in average tons per acre may be due to the limited number (18) of stand exams sampling dead and down surface fuels done in 2009, whereas over
200 plots were taken for the 1998 report and the fact that the helicopter units were not sampled in 2009 and may have had higher fuel loading.

**Environmental Consequences**

**Alternative A - No Action**

Under this alternative, none of the remaining fuels reduction actions proposed would be implemented. The current fuel conditions and their associated fire risks would be maintained and continue to increase with time. The 1998 Fire and Fuels Report adequately described environmental consequences of this alternative.

**Direct & Indirect Effects**

Under this alternative, the effect of no action is that surface fuel loading and ladder fuels would not be reduced resulting in increased fire behavior (expressed in flame length, rate of spread and probability of torching). Surface and ladder fuels would continue to develop and dead fuels would continue to accumulate as trees fall down. In the event of a wildfire, tree mortality would be at or close to 100% and fire behavior would limit fire suppression capabilities—risking both public and fire fighter safety.

**FFE-FVS Analysis**

The following tables display the results of the FFE-FVS analysis for the tractor units under the No Action Alternative A.

**Table 3. Effects of a wildfire on fire behavior characteristics under the No Action Alternative A for the analyzed (743) acres of tractor units.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Type of Fire</th>
<th>Flame Length Surface (feet)</th>
<th>Rate of Spread (chains/hr)</th>
<th>Canopy Base Height (feet)</th>
<th>Probability of Torching</th>
<th>Torching Index (miles/hour)</th>
<th>Crown Index (miles/hour)</th>
<th>Fuel Model/weighted percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Condition</td>
<td>Passive</td>
<td>4.9</td>
<td>13.9</td>
<td>4</td>
<td>38%</td>
<td>0</td>
<td>23.8</td>
<td>10</td>
</tr>
<tr>
<td>After 10 yrs</td>
<td>Passive</td>
<td>4.7</td>
<td>24.3</td>
<td>2</td>
<td>31%</td>
<td>0</td>
<td>17.8</td>
<td>10</td>
</tr>
<tr>
<td>After 20 yrs</td>
<td>Passive</td>
<td>4.6</td>
<td>24.5</td>
<td>4</td>
<td>57%</td>
<td>0</td>
<td>14.0</td>
<td>10</td>
</tr>
</tbody>
</table>

**Exceeds thresholds**

**Table 4. Effects of a wildfire under 90th percentile fire weather and fuels conditions on potential tree mortality (by size class) under the No Action Alternative A for the analyzed (743) acres of tractor units.**

<table>
<thead>
<tr>
<th>Year*</th>
<th>Potential Mortality by dbh (in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0-5.0</td>
</tr>
<tr>
<td>Existing Condition</td>
<td>100%</td>
</tr>
<tr>
<td>After 10 yrs</td>
<td>100%</td>
</tr>
<tr>
<td>After 20 yrs</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Exceeds thresholds**

As the tables above demonstrate, a wildfire would have undesirable fire behavior characteristics and effects. Flame length and rate of spread exceed thresholds. A fuel model 10 with canopy base heights 4 feet and under and a flame length over 4 feet increase the probability of torching. With a torching index of zero, no wind would need to be present for torching trees or a passive crown fire to occur. In 20 years,
a crown fire could be sustained with a 20-foot wind speed of 14 mph. The 90th percentile 20-foot wind for the project area is 14 mph.

In summary the fire intensity (combination of flame length, rate-of-spread and torching potential) that could be generated under Alternative A would lead to the indirect effect of extensive mortality of trees of all sizes within the next two decades (See Table 4).

**Cumulative Effects**

The cumulative effect area is considered to be the entire Ice Timber Sale & Fuels Reduction Project area (not just the tractor units), Greenhorn Mountain ridgeline, and the community of Alta Sierra.

Recent past and current activities within and near the Ice project include: Red Mountain Thinning Project (just south of the project area), commercial logging within and adjacent to the community of Alta Sierra (unrelated to the Ice project), community hazardous fuel reduction projects, and the fuel reduction treatments that have already occurred under 1998 Revised Ice Project EA (Appendix C). The objectives of these activities include limiting the size and severity of wildfires to reduce safety risks to both property owners and fire suppression personnel, personal property within the Alta Sierra Community, and natural resources. The fuels reduction activities that have occurred on private lands and other fuels reduction projects have reduced some surface and ladder fuels, and not the extensive canopy cover in vicinity of communities. As a result, there is still a need to reduce fuels across this landscape to reduce the potential of a stand-replacing event that would burn through the communities as well.

Alternative A would not compliment these past, present, or foreseeable activities, because it neither reduces future fuel loading nor potential fire behavior. No action alternative in combination with other past, present or reasonably foreseeable projects would result in no reduction of fire intensity and size in the long-term, as shown in Tables 3 and 4. The cumulative effect of the limited scope of existing fuels reduction in the vicinity, and implementing Alternative A (no action) would result in little contribution to the reduction of potential fire behavior across the landscape. It would not meet or move towards the LRMP Standards and Guidelines or current regulatory direction. Finney (2001) and Spencer et al. (2008) found that modeled fire effects at the landscape level were modified when approximately 30-35 percent of the landscape had been treated to reduce fuels. The total estimated fuels reduction activities that have taken place on private or public lands in the project area within the past decade are 7 percent of the watershed area. This would continue contributing to the apparent trend toward increasing deforestation in national forests in California resulting from broad scale wildfires (http://www.fs.fed.us/r5/rsl/projects/postfirecondition/).

**Alternative B - Proposed Action**

For the tractor units, this alternative proposes to:

- Thin by tractor logging approximately 743 of mixed conifer stands.
- No tree larger than 30 inches dbh would be harvested (other than for safety needs).
- Activity fuels (slash) created from the thinning operation would be lopped and scattered to no greater than 18 inches in depth in tractor units and then treated with a prescribed underburn.
- Concentrations of heavy fuels, along road systems and trails and wildland urban defense zones may be piled and burned prior prescribed underburning.
- Pre-treatment activities designed to protect natural resources during the underburn will be conducted throughout the burn unit boundaries. These pre-treatment activities may include constructing firelines, limbing trees to reduce ladder fuels and breaking up surface fuel concentrations, piling and burning concentrations of heavy fuel loads prior to underburning.
Direct and Indirect Effects

As shown in Table 5, this alternative would raise the canopy base height, reduce surface and ladder fuels, and reduce potential fire behavior to a level that would limit the severity of wildfire and reduce the risk to fire fighting personnel. With an increase in canopy opening, more opportunities for new growth would occur. Within 10 years, fuel model 8 would represent 94% of the project area and flame lengths would be sustained at under two feet. Alternative B would limit the probability of crown fire initiation to less than 8%, and potential tree mortality to under 16% (>10”dbh size class) for up to 20 years. It would convert the current fuel model 10 to a fuel model 8, leaving the tractor units open with significantly less surface and ladder fuels.

Mechanical treatments, followed by prescribed burning or pile burning, are effective for reducing crown fire potential and predicted tree mortality. This type of treatment creates low surface fuel loads and increased vertical and horizontal canopy separation (Stephens et al. 2009).

FVS Analysis

The following tables display the results of the FVS analysis for the 2010 Revised Ice Timber Sale & Fuels Reduction Project Proposed Action Alternative B.

Table 5. Effects of a wildfire on fire behavior characteristics under the Proposed Action Alternative B for the analyzed (743) acres of tractor units.

<table>
<thead>
<tr>
<th>Year</th>
<th>Type of Fire*</th>
<th>Flame Length Surface (feet)</th>
<th>Rate of Spread (chains/hr)</th>
<th>Canopy Base Height (feet)</th>
<th>Prob. of torching</th>
<th>Torching Index (miles/hour)</th>
<th>Crown Index (miles/hour)</th>
<th>Fuel Model/weighted percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Treatment</td>
<td>S</td>
<td>1.1</td>
<td>1.0</td>
<td>19</td>
<td>0%</td>
<td>384.6</td>
<td>34.2</td>
<td>8 100</td>
</tr>
<tr>
<td>After 10 yrs</td>
<td>S</td>
<td>1.9</td>
<td>1.8</td>
<td>26</td>
<td>3%</td>
<td>383.1</td>
<td>30.2</td>
<td>8 94 5</td>
</tr>
<tr>
<td>After 20 yrs</td>
<td>S</td>
<td>2.0</td>
<td>1.4</td>
<td>8</td>
<td>8%</td>
<td>116.4</td>
<td>27.9</td>
<td>8 91 10 9</td>
</tr>
</tbody>
</table>
* S = surface fire

Table 6. Effects of a wildfire under 90th percentile fire weather and fuels conditions on potential tree mortality (by size class) under the Proposed Action Alternative B for the analyzed (743) acres of tractor units.

<table>
<thead>
<tr>
<th>Year*</th>
<th>Potential Mortality by dbh (in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0-5.0</td>
</tr>
<tr>
<td>After 1 yr</td>
<td>92%</td>
</tr>
<tr>
<td>After 10 yrs</td>
<td>96%</td>
</tr>
<tr>
<td>After 20 yrs</td>
<td>94%</td>
</tr>
</tbody>
</table>

As the tables above demonstrate, a wildfire 20 years after treatment would have desirable fire behavior characteristics and effects. A majority of the tractor units would be a desirable fuel model 8. Flame lengths would be below 4 feet immediately following treatment and remain below or near 4 feet for 20 years. Rates of spread would be desirable at fewer than 5 chains per hour. With the torching index above 116 mph and a 90th percentile 20-foot wind speed of 14 mph, the chance of trees torching or a passive crown fire would be extremely low. Tree mortality remains under 16% in the size classes greater than 10 inch dbh.

In summary the fire intensity (combination of flame length, rate-of-spread and torching potential) that could be generated under Alternative B would lead to the indirect effect of less mortality of trees of all sizes within the next two decades (See Table 6). In particular, the mortality of larger trees over the next two decades is reduced in this alternative when compared to Alternative A.
Cumulative Effects
Past, present and foreseeable activities are mentioned under the No Action Alternative A above. These projects would reduce roadside fuel loading along primary fire control points (roads), provide safe anchor points for fire fighters to begin attacking the fire, aid in community evacuation efforts, reduce the loss of natural resources and private property.

This alternative, in combination with the other fuels reduction activities described under Alternative A, would have cumulative beneficial effects by substantially reducing potential fire behavior in the treatment areas from which safe suppression operations may be implemented. This alternative would not meet the 30-35 percent of the landscape fuels treated as suggested by Finney (2001) and Spencer et al. (2008). However, it would provide a base or anchor from which future fuels reduction could result in landscape scale changes in fire effects. The individual treated units would be resistant to severe changes in vegetation and resilient or able to return to pre wildfire stand structure much more quickly in the event of a wildfire from outside of the analysis area. As such, treatments within the Ice project could have the effect of minimizing cumulative wildfire effects from points outside of the analysis area.

As a result of implementing Alternative B and the activities that have taken place on private or public lands in the project area, the total estimated fuels reduction would be 20 percent of the watershed area. This could have a cumulative effect of modifying the trend of deforestation in national forests in California from increasing, to maintenance or decreasing deforestation.

**Alternative C – No Commercial Thin**
Alternative C proposes to hand thin 427 acres of mixed conifer stands. The difference between Alternative B and C is that Alternative C thins all of the trees between 5 and 10.9 inches dbh; whereas, Alternative B leaves 40 trees per acre in the 5 to 10.9 inches dbh size class, and commercially thins trees up to 30 inches dbh. In addition, Alternative B thins 743 acres of mixed conifer stands.

This alternative proposes to:

- Hand thin 427 acres of mixed conifer stands.
- Remove trees between 5 and 10.9 inches dbh. No tree larger than 10.9 inches dbh would be harvested (other than for safety needs).
- Activity fuels (slash) created from the thinning operation would be lopped and scattered to no greater than 18 inches in depth in tractor units and then treated with a prescribed underburn.
- Concentrations of heavy fuels, along road systems and trails and wildland urban defense zones may be piled and burned prior prescribed underburning.
- Pre-treatment activities designed to protect natural resources during the underburn will be conducted throughout the burn unit boundaries. These pre-treatment activities may include constructing firelines, limbing trees to reduce ladder fuels and breaking up surface fuel concentrations, piling and burning concentrations of heavy fuel loads prior to underburning.

Direct and Indirect Effects
This alternative would have similar direct and indirect effects as the Proposed Action Alternative B.

This alternative would also reduce surface and ladder fuels, and potential fire behavior to a level that would limit the severity of wildfire and reduce the risk to fire fighting personnel. Within 20 years, fuel model 8 would represent 81% of the project area and flame lengths would sustain to under three feet. There would be no chance of crown fire initiation, and potential tree mortality would be less than 15% (>10” dbh size class). This alternative would also convert the current fuel model 10 to a fuel model 8, leaving the units open with significantly less surface and ladder fuels.
**FVS Analysis**

The following tables display the results of the FVS analysis for the 2010 Revised Ice Timber Sale & Fuels Reduction Project No Commercial Thin Alternative C.

**Table 7. Effects of a wildfire on fire behavior characteristics under the No Commercial Thin Alternative C.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Type</th>
<th>Flame Length (feet)</th>
<th>Rate of Spread (chains/hr)</th>
<th>Canopy Base Height (feet)</th>
<th>Prob. of Torching</th>
<th>Torching Index (miles/hour)</th>
<th>Crown Index (miles/hour)</th>
<th>Fuel Model/weighted percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Model</td>
</tr>
<tr>
<td>Post Treatment</td>
<td>S</td>
<td>1.1</td>
<td>1.0</td>
<td>26</td>
<td>0%</td>
<td>559.6</td>
<td>27.3</td>
<td>8</td>
</tr>
<tr>
<td>After 10 yrs</td>
<td>S</td>
<td>1.1</td>
<td>1.0</td>
<td>33</td>
<td>0%</td>
<td>762.7</td>
<td>25.0</td>
<td>8</td>
</tr>
<tr>
<td>After 20 yrs</td>
<td>S</td>
<td>2.6</td>
<td>1.7</td>
<td>9</td>
<td>0%</td>
<td>91.9</td>
<td>24.4</td>
<td>8</td>
</tr>
</tbody>
</table>

*S = surface fire

**Table 8. Effects of a wildfire under 90th percentile fire weather and fuels conditions on potential tree mortality (by size class) under the No Commercial Thin Alternative C.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Potential Mortality by dbh (in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0-5.0</td>
</tr>
<tr>
<td>After 1 yr</td>
<td>89%</td>
</tr>
<tr>
<td>After 10 yrs</td>
<td>84%</td>
</tr>
<tr>
<td>After 20 yrs</td>
<td>98%</td>
</tr>
</tbody>
</table>

As the tables above demonstrate, a wildfire 20 years after treatment would have desirable fire behavior characteristics and effects. Flame lengths would be below 4 feet immediately following treatment and remain at under 4 feet after 20 years. Rates of spread would be desirable at fewer than 5 chains per hour. With the torching index above 91 mph and a 90th percentile 20-foot wind speed of 14 mph, the chance of trees torching or a passive crown fire would be extremely low. Tree mortality would remain under 15% in the size classes greater than 10 inch dbh.

In summary the fire intensity (combination of flame length, rate-of-spread and torching potential) that could be generated under Alternative C would lead to the indirect effect of less mortality of trees of all sizes within the next two decades (See Table 8). In particular, the mortality of larger trees (Trees 10-20 inches) over the next two decades is reduced slightly more in this alternative when compared to Alternative B.

**Cumulative Effects**

Past, present and foreseeable activities are mentioned under the No Action Alternative A above. These projects would also reduce roadside fuel loading along primary fire control points (roads), provide safe anchor points for fire fighters to begin attacking the fire, aid in community evacuation efforts, reduce the loss of natural resources and private property.

This alternative, in combination with the other fuels reduction activities described under Alternative A, would also have cumulative beneficial effects by substantially reducing potential fire behavior in the treatment areas from which safe suppression operations may be implemented. This alternative would not meet the 30-35 percent of the landscape fuels treated as suggested by Finney (2001) and Spencer et al. (2008). However, it would provide a base or anchor from which future fuels reduction could result in landscape-scale changes in fire effects. The individual treated units would be resistant to severe changes in vegetation and resilient or able to return to pre wildfire stand structure much more quickly in the event
of a wildfire from outside of the analysis area. As such, treatments within the Ice project could have the effect of minimizing cumulative wildfire effects from points outside of the analysis area.

As a result of implementing Alternative C and the activities that have taken place on private or public lands in the project area, the total estimated fuels reduction would be 20 percent of the watershed area. This is the same as Alternative B because the number of acres being treated between the alternatives is the same. This could have a cumulative effect of modifying the trend of deforestation in national forests in California from increasing, to maintenance or decreasing deforestation.

Air Quality
The analysis area lies in the Kern County Air Pollution Control District (APCD). It is in non-attainment status for PM10, PM2.5 and Ozone. The Dome Land Wilderness is a Class 1 Air Shed and is located 15 miles northeast of the analysis area. The community of Alta Sierra will be impacted by smoke. The communities of Wofford Heights, Glenville, Lake Isabella and Kernville are smoke sensitive areas within an 8-mile radius downhill for the project site that may be impacted by any prescribed burning. Figure 1: 2010 Revised Ice Timber Sale & Fuels Reduction Project Smoke Sensitive Areas shows a 20 mile radius from the project area of smoke sensitive areas. All burning would be conducted under an approved Prescribed Burn Plan in full compliance of Kern County Air Pollution Control District, Title 17 of California Code of Regulations subchapter 2: Smoke Management Guidelines for Agriculture and Prescribed Burning, Rule 417: Agricultural and Prescribed Burning.

No Action Alternative A
Direct and Indirect Effects
This alternative would have no immediate direct adverse effects on air quality. If a wildfire were to occur, the potential indirect effects include degraded air quality and reduced visibility.

Existing and future fuel accumulations would contribute to increased fire intensities and severities. Consumption of the increased fuel loads would increase the amount of smoke emissions. Emissions from wildfire are typically twice those of a prescribed fire on the same acreage due to greater emission factor (Ottmar 2001), fuel consumption and fire intensity.

Wildfire emissions would typically occur during the summer under hot, dry conditions. This is also the typical smog season (May – October) when air quality is typically at its worst due to the higher seasonal temperatures conducive to creating peak ozone concentrations.

Cumulative Effects
The potential for unregulated smoke emissions from a wildland fire could be high and coupled with the potential for smog, the cumulative effect of a large wildfire could result in unhealthy air quality within adjacent urban and rural areas.

Alternatives B and C
Direct and Indirect Effects
The potential for effects to air quality from the fuels reduction treatments are the same for Alternatives B and C, since both alternatives propose the same treatments. Alternative B and Alternative C would have a chance of impacting the Class 1 Air Shed in the Dome Land Wilderness and surrounding communities. Any impacts would be temporary and could last up to a week in duration because all burning would be initiated in accordance with the regulations specified above.
Cumulative Effects

Smoke

The regulatory framework (Title 17) that controls agricultural and wildland prescribed fire in California is designed to control cumulative effects through allocations based on meteorological conditions influencing smoke dispersion. The Sequoia National Forest and other cooperating wildland agencies work closely with the District and the California Air Resources Board to prioritize wildland prescribed fire within the emissions constraints allowed by the regulatory agencies. Under this regulatory structure, cumulative effects are not expected to occur.

The pile burning on private lands and under other current projects, combined with these alternatives’ smoke impacts would also be temporary and overall cumulative impacts are regulated by the Air Quality Control Board. Constraints on air quality could have a cumulative effect of constraining completion of burning activities on units within the Ice Project or burning within the Ice project may constrain burning in adjacent areas. However, the volume of projects adjacent to the Ice project are not likely to result in competition for availability of burn windows for air quality.

Green House Gases and Climate Change

The temperature of the earth’s atmosphere is regulated by a balance between the radiation received from the sun, the amount reflected by the earth’s surface and clouds, and the amount of radiation absorbed by the earth and atmosphere. The so-called greenhouse gases, which include carbon dioxide (CO2) and water vapor, keep the earth’s surface warmer than it would be otherwise because they absorb infrared radiation from the earth and, in turn, radiate this energy back down to the surface. While these gases occur naturally in the atmosphere, there has been a rapid increase in concentrations of greenhouse gases in the earth’s atmosphere from anthropogenic sources since the start of industrialization, which has caused changes in the global climate.

The primary anthropogenic greenhouse gases are:
- Carbon dioxide CO2,
- Methane (CH4),
- Nitrous oxides (N2O), and
- Halocarbons – CFC11, CFC12, CFC 13

The atmospheric concentration of CO2 has increased from a pre-industrial value of about 280 parts per million (ppm) to 379 ppm in 2005, which is an increase of about 35 percent. During the last 10 years, the rate of increase of CO2 since 1980 was about 1.9 ppm (0.5%) per year. Most of the anthropogenic CO2 emissions are primarily attributed to fossil fuel burning, with land-use changes, especially deforestation, providing another significant contribution (Intergovernmental Panel on Climate Change [IPCC], 2007). The level of CO2 in the atmosphere is determined by a complex cycle that involves the exchange of carbon between the atmosphere, the biosphere and the oceans. It is estimated that the oceans and terrestrial biota absorb about half of all CO2 emissions, while the rest accumulates in the atmosphere (IPCC, 2001a).

"..There are two aspects of global climate change that needs consideration:
(1) the potential for actions to influence global climatic change (increased emissions or sinks of greenhouse gases) and
(2) the potential for global climatic change to affect actions. (i.e. to what extent the project activities (both continuing and proposed) contribute, directly or indirectly, to the emission of greenhouse gases and thus to global climate change.)"

Scenarios of Climate Change in California: An Overview. 2006, found:
"…Temperatures in California are projected to rise significantly over the twenty-first century. …magnitudes of the warming vary because of the uncertainties in the climate sensitivity, as expressed by differences between models and in the emission scenarios. The rises (2000 to 2100) vary from approximately 1.7°C–3.0°C (3.0°F–5.4°F) in the lower range of projected warming, 3.1°C–4.3°C (5.5°F–7.8°F) in the medium range, and 4.4°C–5.8°C (8.0°F–10.4°F) in the higher range (Cayan et al. 2006a). To comprehend the magnitude of these projected temperature changes, over the next century the lower range of projected temperature rise is slightly larger than the difference in annual mean temperature between Monterey and Salinas, and the upper range of project warming is greater than the temperature difference between San Francisco and San Jose, respectively…

…This result has important implications for impacts such as ecosystems, agriculture, water and energy demand, and the occurrence of heat waves, which have public health consequences.

There is no clear trend in precipitation projections for California over the next century…

…There is no evidence from the projections indicating that the Mediterranean seasonal precipitation regime in California will change. All of the simulations examined here indicate that the very dominant portion of precipitation continues to be derived during winter from North Pacific storms. Summer precipitation changes only incrementally, and actually decreases in some of the simulations, so there is little evidence for a stronger monsoon influence. For the scenarios reported here, each of the model runs is characterized by large interannual to decadal fluctuations of precipitation, but not much change in annual precipitation over the 2000–2100 period. Little change in variability over the period of the model runs is evident in the simulations. The frequency of warm tropical events (El Niños) remains about the same as was exhibited in the historical simulations…"

Wiedinmyer and Hurteau. 2010, found:

"…Currently, forests in the U.S. sequester approximately 10% of the annual U.S. anthropogenic emissions. While carbon sequestration by forests provides an important ecosystem service, relying on the continued strength of this sink is tenuous at best given the influence of changing climatic conditions on these ecosystems and the projected decline in the sink strength even with continued suppression.

… In the dry, fire prone forests of the western U.S., wildfire size and severity have been increasing as a result of changing climatic conditions and past management activities. Wildfire, in addition to being an impediment to meeting the permanence requirement for generating forest carbon offsets, is also a significant source of carbon emissions. Reducing the risk of high severity fire in the dry forest types of the western U.S. requires a reduction in forest carbon stocks. Despite these reductions, carbon continues to accumulate as a result of forest growth following treatment implementation.

The results of this study suggest that prescribed burning could reduce CO2 and other emissions from fires in dry forest types by 52-68%. This equates to overall fire emission reduction in the western U.S. of 18-25%, and as much as 35% at the state level…"
…the total potential emissions reduction should be viewed with the caveat that large fire events, such as the Yellowstone fires in 1988, would increase the total wildfire emissions and decrease the total emissions reduction from prescribed fire. This is due to the fact that the Yellowstone fires burned within the historic range of variability for this system and regular prescribed fire would be an inappropriate management technique.

Prescribed burning is a potential way to manage CO2 fluxes from forests in regions with high wildfire activity such as the western U.S. Managing forest fuels with prescribed fire requires repeated application at a frequency that is appropriate to meet management goals, and quantifying the carbon costs would require an assessment of the cumulative emissions coupled with quantification of sequestration by the remaining trees. In cases where high severity fire can transition the forest from a sink to a source for an extended period of time, cumulative prescribed fire emissions are likely to be lower than wildfire emissions coupled with lost sink strength. However, in systems where tree regrowth is faster, repeated prescribed burning may have a higher carbon cost than a one-time wildfire event. The purpose of this work was to set an upper bound for the potential reduction in CO2 emissions that could be achieved when prescribed fire replaces wildfire. These findings indicate that prescribed burning emissions on a per fire basis are considerably lower than emissions from wildfire. Furthermore, live tree mortality rates from prescribed burning are typically lower than from wildfire, and the remaining live trees continue to sequester carbon. While prescribed burning does not eliminate the occurrence of wildfire in these systems, there is evidence that treating fuels limits the severity of wildfire when it does occur because of limited fuel availability. This study is a first step in evaluating the potential of using prescribed fire to reduce wildfire emissions and increase the long-term stability of forest carbon. These results can support the determination of regional C fluxes within the U.S. and help constrain the potential emissions reductions that can be achieved through prescribed burning…

In accordance with the current science summarized above and the regulatory requirements for fuels reduction activities, implementation of either action alternative in the Ice Project should have a negligible cumulative potential to generate greenhouse gases. These effects would be negligible whether counted as a source or a sink for greenhouse gases.
Figure 1. 2010 Revised Ice Timber Sale & Fuels Reduction Project Smoke Sensitive Areas
Summary

This report is a conservative analysis of the existing conditions and potential fire severity. The 1998 Fire and Fuels report may be a more accurate depiction of the effects of a wildfire event. As stated earlier surface fuel loadings used for this report were significantly less those of the 1998 report. In addition, average slopes of the tractor and hand thinning units were less than the overall Ice project area, thus reducing potential fire effects. Other new information to supplement the 1998 report is the canopy base height, probability of torching, torching and crown index. All these outputs emphasize the importance of ladder fuel reduction. The 1998 Fire and Fuel Report of the Revised Ice Timber Sale and Fuels Reduction Project should still be considered valid.

The percentage of tree mortality is what is important to glean from this Fire and Fuels Supplemental Information Report. Without any fuels treatment (No Action Alternative A), tree mortality in all size classes would be near or at 100%. Alternative B and C’s treatments would limit tree mortality below 16% (>10”dbh size classes). Both alternatives would create forest conditions conducive to limiting the size and severity of a wildfire by reduce surface fuel loading and ladder fuels. Suppression efforts would have higher rates of success and firefighter safety would be increased. Furthermore, both alternatives propose to prescribed underburn a total of 2,340 acres. Of the two action alternatives, Alternative B proposes to pre-treat more acres (316 acres more than Alternative C) prior to underburning and therefore there would be more flexibility in the prescribed burning prescription and burn window.

Recommendations

• Maintain fuel treatments

Maintain fuel treatments every 10 years through prescribed underburning. A prescribed underburn schedule will decrease cost by limiting pre-treatment activities such as hand thinning and pile burning. Maintaining surface fuel loading and ladder fuels will reduce potential fire behavior to a level that would limit the severity of wildfire and reduce the risk to fire fighting personnel.

It is important that fuel treatments be maintained through ladder fuel reduction and prescribed fire, so that if a fire should occur, the potential for crown fire is minimized and fire crews can be effective (Graham et al. 2004).

• Mechanical fuel treatment for chaparral

The “1998 Revised Ice Timber Sale and Fuel Reduction Project Fire and Fuels Report” used the BEHAVE fire prediction model and estimated a wildfire to be uncontrollable in the chaparral areas without treatment of prescribed underburning. Prescribed underburning was attempted numerous times by fire resources under prescription parameters that predicted low to moderate fire behavior that limited the chances for an escape or uncontrollable wildland fire. Under prescription parameters, fire effects were not desirable, chaparral did not consume, and fuel loading was not reduced significantly. A hotter prescription was needed but too risky due to the steep slope, predicted flame lengths, rate of spread, and the forested community of Alta Sierra above the project area and brush community of Wofford Heights below the project area. Therefore, Management decided not to proceed with underburning the 1,480 acres of chaparral located in the lower elevations of the project area.

For suppression tactics or prescribed fire to be successful in the chaparral component, vegetative manipulation must occur. Chaparral within the project area should be treated primarily with mechanical means due to the risk associated with prescribed fire. Chaparral stand treatments will require rearrangement of the fuel profile from an existing vertical component to one that is horizontal and close to the ground. Prescribed fire may be used in areas where mechanical treatments have occurred and have placed the fuels on the ground in areas where risk can be minimized. Effective treatments may include methods of crushing, grinding, and chipping stands of chaparral.
• Increase pre-treatment activities in the conifer zone prior to prescribed underburning
The conifer zone of the project area contains densely stocked stands of mixed conifer, mainly in small and medium size classes of 0-10.9” dbh cedar and fir tree species. The “1998 Revised Ice Timber Sale and Fuel Reduction Project Fire and Fuels Report” does account for additional pre-treatment activities designed to protect natural resources during underburning. However, the 2010 Revised EA should emphasis and clearly state pre-treatment activities to include all areas of excess fuel loading (including ladder fuels in the 0-10.9” size class) and activity fuels to be cut, piled and burned throughout the entire project area.

• Include the area between 25S15 and 25S17 roads into the project area
Additionally treating fuels to include the area 25S15 and 25S17 roads creates a fuel break along a ridgeline, road system and provides additional wildfire protection from the community of Alta Sierra. It is unlikely that the underburning west of the 25S17 road will be accomplished as the 1998 EA proposes. Fire lines would have to be constructed mid slope on a 40% slope. Firefighters would be at risk from injury or rolling material igniting fire below. A prescribed underburn between the two roads or along the ridgeline is safer, more effective, and more likely to occur.

References


California Energy Commission, 2006. Scenarios of Climate Change in California: An Overview


Rothermel, Richard C. 1983. How to Predict the Spread and Intensity of Forest and Range Fires. Gen Tech Rep. INT-143, USDA, FS, Intermountain Range and Experiment Station, Ogden, UT.


Consultation with (non-core IDT members):
Bergman, Brian. District Forester Timber Sales, Kern River Ranger District, Sequoia National Forest.
Dauwalder, Pat. District Timber Sale Administrator, Kern River Ranger District, Sequoia National Forest.
Jones, Dave. Air Pollution Control Officer, Kern County Air Pollution Control District.