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## FUELS MANAGEMENT

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# SHORT FEATURES

## On the Cover:

*Job Corp crewmembers Aaron Slack and Paul Almona putting in handline on the 1,625-acre Chestnut Ridge prescribed burn on the Greenbrier Ranger District of the Monongahela National Forest during the spring of 2009.*
*Photo by Peter Fischer*

The USDA Forest Service's Fire and Aviation Management Staff has adopted a logo reflecting three central principles of wildland fire management:

- *Innovation:* We will respect and value thinking minds, voices, and thoughts of those that challenge the status quo while focusing on the greater good.
- *Execution:* We will do what we say we will do. Achieving program objectives, improving diversity, and accomplishing targets are essential to our credibility.
- *Discipline:* What we do, we will do well. Fiscal, managerial, and operational discipline are at the core of our ability to fulfill our mission.

**Firefighter and public safety is our first priority.**

# ANCHOR POINT

by Tom Harbour
Director, Fire and Aviation Management
Forest Service

## GOOD IDEAS MATTER

Many good ideas have been defined, refined, and implemented over more than a century of wildland fire management. Ideas such as the advent of the Pulaski, the fire shelter, personal protective equipment, national training standards, and the implementation of interagency coordination are just a few that come immediately to mind.

The first Quadrennial Fire and Fuels Review (QFR) in 2004 and the subsequent QFR in 2009 represent another beneficial idea: a strategic assessment process to evaluate current mission strategies and capabilities against best estimates of the future environment for fire management. A QFR creates an integrated strategic vision document for fire management and provides a solid foundation for policy discussion within the five Federal natural resource management agencies (Forest Service, Bureau of Land Management, National Park Service, Bureau of Indian Affairs, and U.S. Fish and Wildlife Service)—and more importantly, among the Federal agencies and their State, local, tribal, and other partners. It sets the stage for a "strategic conversation" within the wildland fire community about the future direction and changes in wildland fire management.

> If we fail to share our ideas with others, we stand to lose an opportunity to make a difference—to solve some of those issues identified in the QFR and the cohesive strategy.

Another good idea was revealed when interagency coordination and collaboration reached unprecedented levels through the three phases of the National Cohesive Wildland Fire Management Strategy. The process that started as an effort to develop a cohesive strategy to address the wildland fire problems across America has encouraged and fostered a greater level of collaboration across landscapes to address the three major factors of the strategy—restore and maintain resilient landscapes, create fire-adapted communities, and respond to wildfire. We have always worked in tandem with our partners when a wildfire happens, but the cohesive strategy has encouraged us to look across landscapes and jurisdictions to work together not only when the fire bell rings but also to prepare for and learn to live with fire as a natural occurrence. Are we there yet? No, but we have made great strides.

As American Humorist Arnold H. Glasow noted, "*Success isn't a result of spontaneous combustion. You must set yourself on fire.*" What did he mean? Maybe, that ideas matter; without those who dared to share ideas in the past, we would be nowhere today.

If we fail to share our ideas with others, we stand to lose an opportunity to make a difference—to solve some of those issues identified in the QFR and the cohesive strategy. So, I would challenge you: what are the good ideas of the future? With changing demographics, increasing impacts on the wildland-urban interface, declining health of our forests and rangelands, and the subsequent increasing severity of wildfires, we need your help. You are our experts in the field.

Considering those three major factors of the cohesive strategy, I would ask that you be part of the solution and share your ideas with your supervisor—share them with me. Together, we can do more! ■

# QUANTIFYING THE POTENTIAL IMPACTS OF FUEL TREATMENTS ON WILDFIRE SUPPRESSION COSTS

Matthew P. Thompson, Nicole M .Vaillant, Jessica R. Haas,
Krista M. Gebert, and Keith D. Stockmann

*This article is a condensed and slightly edited version of a previously published article appearing in the Journal of Forestry (Thompson et al. 2013). Readers wishing for more detail on study motivation, relevant literature, data sources, modeling methods, and the full presentation of results are encouraged to refer to the article in its entirety, which is available from the author or through the journal.*

## Introduction

Modeling the impacts and effects of hazardous fuel reduction treatments is a pressing issue within the wildfire management community. Prospective evaluation of fuel treatments allows for comparison of alternative treatment strategies in terms of socioeconomic and ecological impacts and facilitates analysis of tradeoffs across land management objectives (Stockmann et al. 2010). While much attention has been focused on assessing how fuel treatments affect expected loss to highly valued resources and assets (e.g., Ager et al. 2007), some have also suggested benefits from fuel treatments in terms of avoided suppression costs (Snider et al. 2006). In this paper, we demonstrate a methodology for estimating potential reductions in wildfire suppression costs. Our approach pairs wildfire simulation outputs with a regression cost model and quantifies the influence of fuel treatments on distributions of wildfire sizes and suppression costs. Estimates of suppression cost reductions can ultimately be compared to treatment costs within a cost-benefit framework.

Motivation for this study stems from four important sources. First, escalating Forest Service wildfire management costs have resulted and may continue to result in reduced budgets and potentially disruptive within-season borrowing to nonfire programs, challenging the ability of the agency to meet societal needs and maintain forest health (Thompson et al. 2013). Second, suppression costs are known to be positively and highly correlated with fire sizes and area burned (Liang et al. 2008, Calkin et al. 2005). Third, modeling efforts and post-fire analyses suggest that fuel treatments can significantly affect fire spread and final fire size (Cochrane et al. 2012, Collins et al. 2011, Hudak et al. 2011, Ager et al. 2010, Finney 2007). Lastly, fuel treatments can also lead to reductions in final fire size by providing opportunities for enhanced suppression (Hudak et al. 2011, Syphard et al. 2011, Graham et al. 2009, Moghaddas and Craggs 2007).

## Methods

### Framework

The evaluation of potential cost impacts involves first modeling how treatments will impact fire behavior, and, in turn, modeling how altered fire behavior may impact suppression costs. Figure 1 provides a conceptual framework detailing how the biophysical and socioeconomic context, treatment objectives, and treatment impacts relate to our modeling approach. The likelihood, extent, and intensity of fire, along with the density and spatial pattern of values-at-risk, jointly influence treatment strategies and design objectives (Calkin et al. 2011). In some contexts, this may entail creating areas of low fire intensity and hazard, and fire sizes might actually increase as part of

Estimates of suppression cost reductions can ultimately be compared to treatment costs within a cost-benefit framework.

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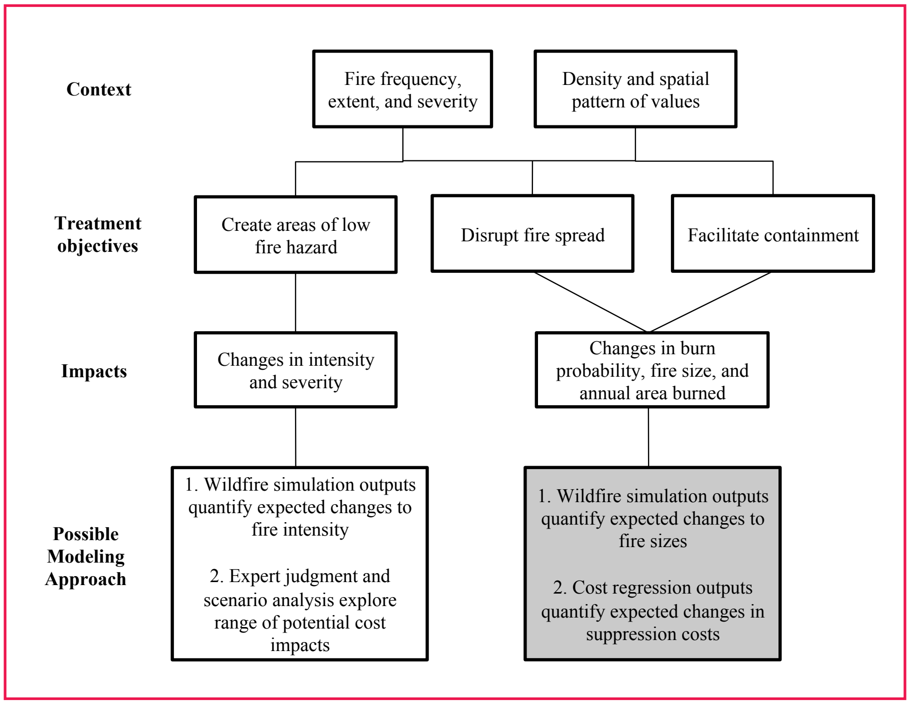

**Figure 1.**—*Conceptual framework for evaluating potential cost impacts of fuel treatments (our approach is highlighted in gray).*

restoring historical fire regimes. In other contexts, treatment strategies are oriented more towards resource protection and the inhibition of fire growth across the landscape.

Multiple mechanisms exist by which fuel treatments could affect suppression costs. Reduced intensity will in many contexts lead to reductions in burn severity (Wimberly et al. 2009, Martinson and Omi 2008), enabling opportunities for resource benefit and moderated suppression responses. These changes in wildfire management could in turn lead to suppression cost reductions. However, Gebert and Black (2012) recently found that less aggressive protection strategies may ultimately lead to costs on par with or higher than more aggressive strategies, owing to longer durations and increased acreages burned.

Another mechanism is to change fire size distributions, which, to reiterate, are a major determinant of suppression costs. Here we focus on fire size as a primary variable affecting suppression cost estimates (figure 1). The foundation of our approach is the coupling of two peer-reviewed models used by the Forest Service and other Federal land management agencies: (1) FSim (Finney et al. 2011), a spatially explicit large fire (defined at 300 acres or more) occurrence, spread, and containment model and (2) a large-fire cost model (Gebert et al. 2007). The use of a fire growth simulation model approach allows us to directly model disruptions in fire spread and subsequent impacts to fire size. In our approach, therefore, all else being equal, treatments resulting in reduced fire spread will tend to decrease fire size, in turn reducing fire cost.

## Fuel Treatment Cost Impact Modeling

Simulating the occurrence and growth of wildfires across the current and hypothetically treated landscapes enables evaluation of changes in fire behavior and, therefore, treatment impacts. Fire size potential is jointly driven by the spatial continuity of fuels and temporal opportunities for spread. To compare simulation results with and without fuel treatments, we set up FSim runs to use identical ignition locations and weather conditions for both scenarios. Thus, weather conditions are controlled for, and changes to modeled final fire size are attributed to, treatment effects (although there is some stochasticity introduced via spotting). Differences in estimated suppression costs (a function of changed fire sizes) reflect expected suppression cost differences due to treatment.

The basic steps of the overall analysis procedure are outlined below. Data needs include an up-to-date map of landscape fuels, spatially delineated fuel treatments, and projected fuel conditions after treatment.

1. Obtain or create up-to-date fuels data to represent existing conditions.
2. Obtain historical fire occurrence data and identify appropriate RAWS (Remote Automated Weather Station) for fire weather data.
3. Design and spatially lay out prospective fuel treatments.
4. Modify existing conditions fuels data to reflect fuel treatments.
5. Generate FSim wildfire simulation model outputs with and without fuel treatments.
6. Aggregate and feed variables output from FSim into the regression cost model to estimate the expected suppression cost for each simulated fire.
7. Compare expected suppression costs with and without fuel treatments, across fires, and across simulated fire seasons.

## Case Study: Deschutes Collaborative Forest Project

The Deschutes Skyline Project, commonly referred to as the Deschutes Collaborative Forest Project (DCFP), was one of the first 10 projects approved and funded under the Collaborative Forest Landscape Restoration Program and was selected as a pilot study for modeling the impacts of fuel treatments on expected suppression costs. Figure 2 provides a map of the analysis landscape (516,962 acres), as well as the DCFP project area, most of which is located within the Deschutes National Forest (145,000 acres total, 112,000 acres of which are National Forest System land), in west-central Oregon. Also identified in figure 2 are the boundaries of seven areas organized for purposes of National Environmental Policy Act analyses, as well as the locations of all ongoing or proposed fuel treatments within the DCFP.

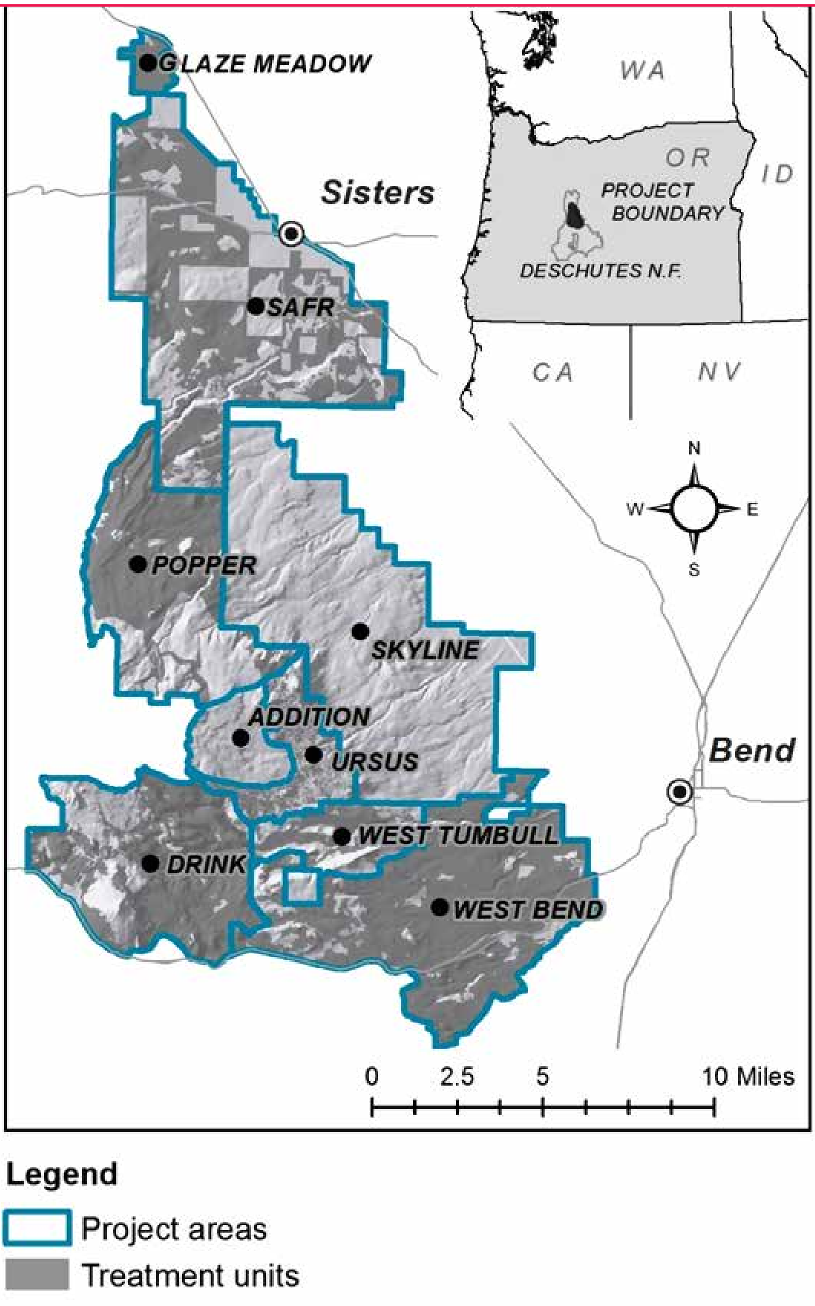

**Figure 2.**—*Map of Deschutes Collaborative Forest Project (Collaborative Forest Landscape Restoration Program) study area, with project areas and treatment units highlighted.*

Deschutes National Forest staff provided data on vegetation and fuel layers reflecting existing conditions (EC), as well as treatment polygons and post-treatment (PT) fuel conditions. In total, 66,808 acres (about 46 percent of the DCFP landscape) are projected to receive treatment during the planning period from 2010 to 2019. For modeling purposes, we used a single landscape to reflect the entire suite of fuel treatments. That is, the post-treatment modeling results represent the cumulative effect of all treatments upon completion of implementation. We set up FSim to simulate fire occurrence and growth for a total of 10,000 simulated fire seasons and included a buffer around the study area of width ranging from 2 to 3 miles to account for offsite ignitions that could burn into the study area. To generate weather files for FSim, we used the Colgate RAWS with data from 1990 to 2010 and fire history information for all fires on the Deschutes National Forest over the same period.

Because of the large spatial extent of the treatments and the combination of mechanical treatments with surface and activity fuel treatment, we hypothesized that reductions in fire sizes and expected suppression costs would occur within the study area. We further hypothesized that treatment effects would be more prominent for those ignitions occurring closer to treated areas. Therefore, we present modeling

**Table 1**—*Percentage reductions to fire size, cost per acre, and cost per fire resulting from treatment, across all large fires igniting within three overlapping landscape areas of increasing size (within treated areas, within a 2-mile buffer of treated areas, and across the entire study area).*[1]

| | Treated areas | 2-mile buffer | Entire study area |
|---|---|---|---|
| | | *percent change* | |
| **Size** | | | |
| Mean | 17.08 | 11.30 | 4.68 |
| Median | 22.24 | 14.97 | 5.55 |
| Min | 0.66 | 0.66 | 0.74 |
| 25th percentile | 12.12 | 5.97 | 2.78 |
| 75th percentile | 23.13 | 13.20 | 7.06 |
| Max | 12.84 | 3.78 | 0.58 |
| **Cost per acre** | | | |
| Mean | -2.24 | -0.60 | 0.53 |
| Median | 0.26 | 0.28 | 1.00 |
| Min | -6.73 | -0.43 | -0.17 |
| 25th percentile | -0.30 | 1.40 | 1.22 |
| 75th percentile | -3.18 | -1.04 | 0.35 |
| Max | -1.74 | 0.00 | 0.00 |
| **Cost per fire** | | | |
| Mean | 15.86 | 10.78 | 6.71 |
| Median | 17.58 | 10.63 | 5.21 |
| Min | -0.48 | 0.25 | -0.78 |
| 25th percentile | 18.60 | 11.30 | 5.05 |
| 75th percentile | 20.57 | 12.91 | 7.04 |
| Max | 5.64 | 1.06 | 2.72 |

[1] *Treatment effects dampen as the area increases, owing to the increasing proportion of fires that do not interact with treatments.*

results for fires that ignited within three overlapping analysis areas of increasing size (within treated areas, within a 2-mile buffer of treated areas, and across the entire study area).

# Results

## Fuel Treatment Effects on Burn Probability, Fire Size, and Suppression Cost

Table 1 presents summary statistics regarding percentage reductions in fire size, cost per acre, and cost per fire resulting from treatment. With respect to size, reductions are most prominent within treated areas, although off-site effects are discernible. Within treated areas, the mean and median fire sizes decrease by 17.08 percent and 22.24 percent, respectively. Within the 2-mile buffer, mean and median fire sizes decrease by 11.30 percent and 14.97 percent, respectively. Treatment effects dampen as the analysis area increases because of the increasing proportion of fires that do not interact with treatments.

Table 1 also indicates increasing cost per acre with decreasing fire size, consistent with both the cost regression model and historical Deschutes data, where smaller fires tend to cost more per acre. Overall per-fire costs decrease, however, because the effects of the reductions in fire sizes overwhelm the effects of increases in per-acre costs. Reductions in cost per fire also lessen as the analysis area increases and are generally comparable in magnitude to reductions in fire size. Within treated areas, the mean and median fire costs decrease by 15.86 percent and 17.58 percent, respectively, and within the 2-mile buffer mean and median fire sizes decrease by 10.78 percent and 10.63 percent, respectively.

**Table 2.**—*Mean annual area burned and suppression costs across all 10,000 simulated fire seasons, across fires igniting within three overlapping landscape areas of increasing size (within treated areas, within a 2-mile buffer of treated areas, and across the entire study area).*

| | **Treated areas** | | | **2-mile buffer** | | | **Entire study area** | | |
|---|---|---|---|---|---|---|---|---|---|
| | *EC* | *PT* | *Reduction* | *EC* | *PT* | *Reduction* | *EC* | *PT* | *Reduction* |
| Area burned | 1,315 ac | 838 ac | 36.25% | 2,494 ac | 1,911 ac | 23.37% | 5,398 ac | 4,799 ac | 11.08% |
| Suppression cost | $1,610,806 | $1,042,147 | 35.30% | $2,848,653 | $2,195,551 | 22.93% | $5,093,335 | $4,432,626 | 12.97% |

*EC = Existing conditions. PT = Post-treatment landscapes.*

### Annual Area Burned and Annual Suppression Costs

Beyond per-fire results, it is important to aggregate individual simulated fire results into unique fire seasons on an annualized basis. This approach captures both those fire seasons in which no large fires occur and those fire seasons in which multiple large fires occur. Across the entire study area there were approximately 160 fewer large fires after treatment, which reflects the effect of fuel treatments on limiting the growth of ignitions to below the 300-acre "large fire" threshold.

Table 2 presents results for annual area burned and annual suppression costs across all 10,000 simulated seasons. The 25th, 50th (median), and 75th percentiles are not presented as they are all equal to zero—this is because the chance of experiencing a large wildfire in any given year is only about 35 percent (for the entire study area)—so there are many years in which no suppression costs are incurred (within the study area, not the entire Deschutes National Forest). The annual area burned and suppression costs increase as the size of the analysis area increases, simply because more fires are included in the sample. Percentage reductions, however, decrease because a smaller fraction of fires interact with treatments. For fires igniting within treated areas, mean annual area burned and suppression costs drop by 36.25 percent and 35.30 percent, respectively, after treatment.

## Discussion and Concluding Remarks

Our analysis demonstrates that planned fuel treatments within the DCFP study area are likely to reduce the number of large fires, fire sizes, and large-fire suppression costs. In a broader sense, our analysis demonstrates a possible method for estimating the impacts of fuel treatments on financial risk. The tools and approaches defined here could inform treatment design and strategy development across land management agencies interested in better managing suppression costs.

There are caveats, assumptions, and limitations to address regarding this work, and therefore, results of this demonstration should be viewed through a critical lens. First, nearly 50 percent of the DCFP project area will receive treatment; impacts to fire sizes and costs may be dampened on landscapes receiving less treatment. Second, results are dependent on the wildfire simulation and regression cost models used, which come with errors and uncertainties, and which at present do not account for the possibility of changed suppression strategies or tactics. Third, changes in wildfire outputs are largely driven by projected changes in fire behavior fuel models. Future applications should focus on careful model calibration and validation (Scott et al. 2012, Stratton 2009), in particular the accuracy of projected fuel conditions before and after fuel treatments. Fourth, the only certain way to reduce suppression expenditures is to make a decision to spend less money, and strong sociopolitical pressures or other factors may encourage aggressive suppression independent of potential changes to fire behavior from fuels treatments. Fifth, at present, the modeling technique addresses cost impacts only from changes to final fire size, not fire intensity. Modeling the cost impacts of reduced fire intensity or severity may require alternative fire modeling approaches or the incorporation of local expertise and professional judgment coupled with scenario analysis.

In summary, we believe we have identified a novel and unique methodology that should inform fuel treatment design and implementation, and that ultimately will facilitate the reduction of wildfire management costs. Despite identified limitations, modeling results can provide useful information about the relative magnitude and direction of change resulting from strategic fuels management. Recommended applications include fuel treatment design where impacting fire sizes and suppression costs are explicit management objectives, and analyses of projects moving forward under the Collaborative Forest Landscape Restoration Program and the National Cohesive Wildland Fire Strategy.

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## Did You Know

For the 2013 fire season, the Forest Service provided a specific Wildland Fire Web site. The site contained information on a variety of subjects associated with the agency’s involvement in wildfire suppression, research, firefighters’ roles, and a host of other items.

# MODELED FOREST INVENTORY DATA SUGGEST CLIMATE BENEFITS FROM FUELS MANAGEMENT

Jeremy S. Fried, Theresa B. Jain, and Jonathan Sandquist

As part of a recent synthesis addressing fuel management in dry, mixed-conifer forests (Jain et al. 2012), we analyzed more than 5,000 Forest Inventory and Analysis (FIA) plots, a probability sample that represents 33 million acres of these forests throughout Washington, Oregon, Idaho, Montana, Utah, and extreme northern California. We relied on the BioSum analysis framework (Daugherty and Fried 2007, Barbour et al. 2008) that integrates several models to evaluate the economics of treating fuels by using 13 different mechanical fuel treatments per plot. We are extending this analysis to explore the carbon dynamics associated with these fuel treatments and to share a conceptual model and preliminary results.

The BioSum framework uses FIA data consisting of high-quality field measurements as the foundation and the Fire and Fuels Extension of the Forest Vegetation Simulator (FFE-FVS) to model silvicultural prescriptions and generate indexes relevant to fire hazard. The Fuel Reduction Cost Simulator (Fight et al. 2006) was used to estimate on-site treatment costs, and a geospatially explicit travel times calculator was used to estimate haul costs. Covering the full study area required 14 different FFE-FVS variants.

We considered three aspects of fire hazard: crown fire potential (as indicated by FFE predictions of torching index and probability of torching [ptorch]); intensity and firefighter safety during initial attack (based on FFE-predicted surface flame height); and wood value, residual stand viability, and carbon emissions risk implications (based on FFE-calculated mortality volume). Our hazard score for each plot was computed as the sum of the number of aspects by which it was rated hazardous on a scale of 0 to 4 (receiving one point for each of four criteria: ptorch >20 percent, torching index <20 mph [miles per hour], surface flame height >4 feet, and mortality volume [as a percentage of prefire live tree volume] > 30 percent). We modeled a variety of treatments aimed at achieving greater crown spacing; removal of ladder fuels; removal of late-seral species to favor retention of fire adapted, early-seral species; and blended approaches. We deemed treatments that reduced hazard score from the no-treatment case as effective and processed and aggregated "cut-lists" produced by FVS to generate estimates of expected yields and value of merchantable and energy wood, as well as both on-site treatment costs and the costs of delivering material from the forest to suitable processing facilities.

By our hazard score calculation, most forested acreage in dry mixed-conifer forests is currently hazardous with respect to at least one hazard criterion.

By our hazard score calculation, most forested acreage in dry mixed-conifer forests is currently hazardous with respect to at least one hazard criterion (figure 1). Between one-tenth (in Utah) and one-third (in northern California and on the Klamath) of hazardous acreage could be effectively treated (achieving a reduction in hazard score) by using 1 or more of the 13 treatments modeled. These opportunities were about equally split between acreage where treatments would pay for themselves and return some net revenue

The prospect of climate benefits depends critically on the likelihood of fire encountering the treated area during the effective lifespan of the treatment.

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*Jeremy S. Fried is a Forest Inventory and Analysis research forester for the Pacific Northwest Research Station, Portland, OR. Theresa B. Jain is a research forester for the Rocky Mountain Research Station, Moscow, ID. Jonathan Sandquist is a forestry technician for the Rocky Mountain Research Station, Moscow, ID* from sales of products, and acreage where we would expect treatments to occur only if subsidized. Where more than one treatment can achieve a reduction in hazard score, we consider the best treatment to be that which minimizes hazard score; when there are ties in that score, they are resolved first by choosing the treatment with the lowest ptorch, and secondarily the treatment with the greatest net revenue. For each geographic subregion within the study area and broad forest type group within dry mixed-conifer, the *Fuel Synthesis Guide* (Jain et al. 2012) provides comprehensive information, in the form of histograms, on treatment effectiveness and economics (for example, net revenue, wood and energy production and value, and costs of treatment and haul).

Some recent studies have suggested that fuel treatments compromise the climate benefits of forests by reducing carbon sequestration and by generating greater net greenhouse gas emissions than would occur with a hands-off or caretaker approach to forest management. On close evaluation, such conclusions typically turn out to be driven by: (1) not including some or all of the out-of-forest climate benefits linked to forest products and biomass-generated energy, (2) using outdated information concerning the magnitude of those benefits (for example, citing studies that overstate mill waste and unutilized harvest residues relative to contemporary norms), (3) not fully accounting for mortality in unmanaged stands, or (4) evaluating study areas in which wildfires are comparatively rare.

To bring systematic FIA data representing all forested lands to bear on this question, we extended the BioSum analysis summarized in

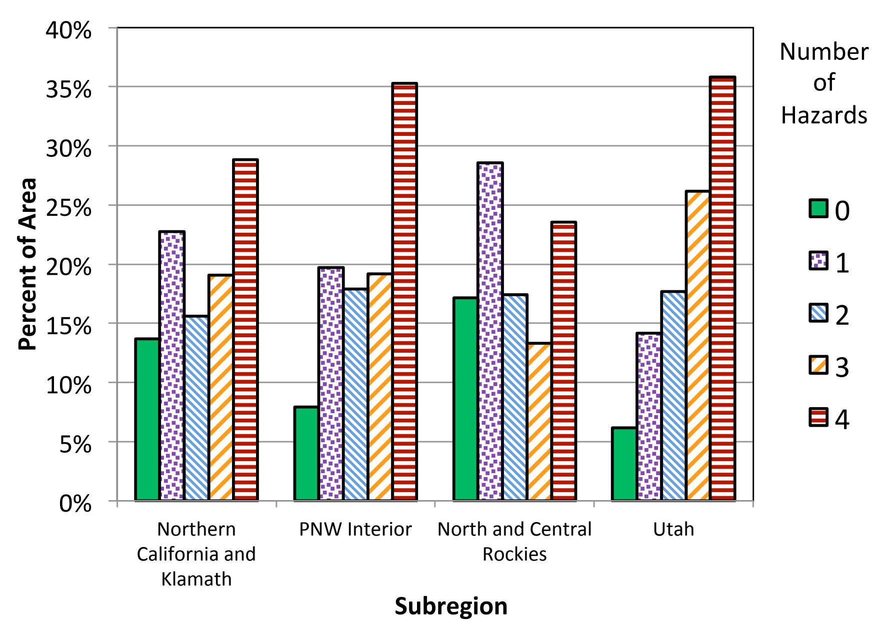

**Figure 1.**— *Percentage of area within each subregion by hazard score (number of ways rated hazardous).*

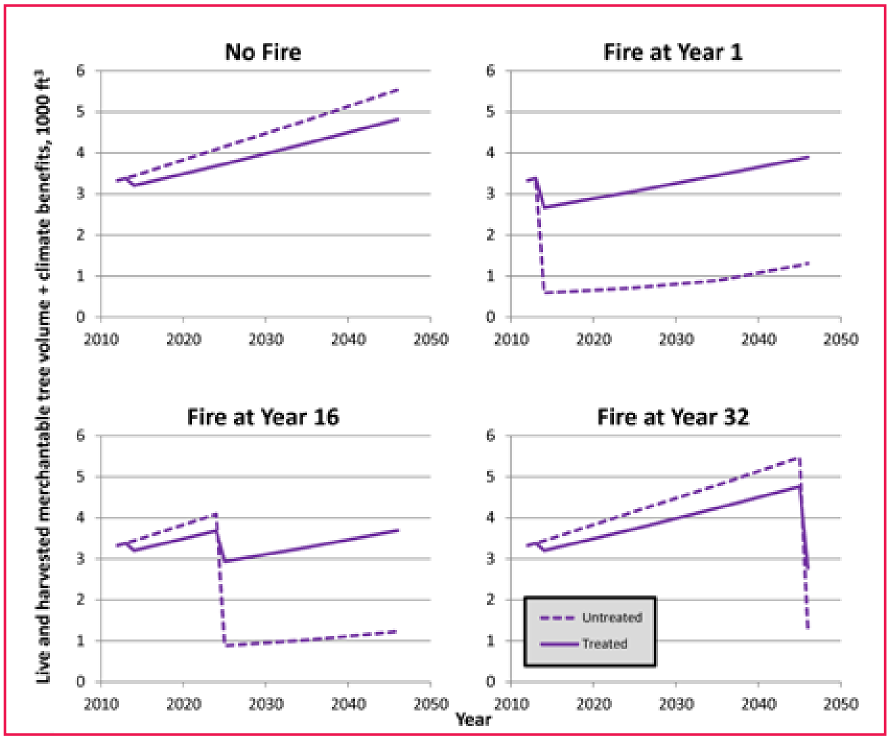

**Figure 2.**— *Trajectories of mean, per acre, merchantable volume (no treatment case), and merchantable volume plus products effects (best treatment case) for 4 fire scenarios, based on 132 plots in Douglas-fir and true fir forests representing 1.2 million acres.*

the *Fuel Synthesis Guide* by using FVS to project effectively treated plots forward for 32 years under four alternative fire scenarios: no fire and fire under severe, but not extreme, weather conditions at 1, 16, and 32 years following treatment.

Each scenario results in a trajectory of in-forest carbon and out-of-forest carbon and greenhouse gas implications that we summarize for the Douglas-fir and true fir forest type group (figure 2). We focused on live tree boles in part because of the difficulty in obtaining accurate estimates of other carbon pools and also because of the availability of comparatively accurate volume estimation models. These models account for the largest share of forest carbon that changes over the life of a stand and generates substantial out-of-forest climate impacts that are often underestimated.

We used a multiplier of 1.23 (Stewart and Nakamura 2013) to account for the climate implications of woody carbon moved from the forest to storage in products and landfills, the substitution of wood for materials such as metal and concrete that are responsible for substantial fossil energy emissions (Malmsheimer et al. 2011), and the substitution of woody biomass-generated energy for fossil fuel energy.

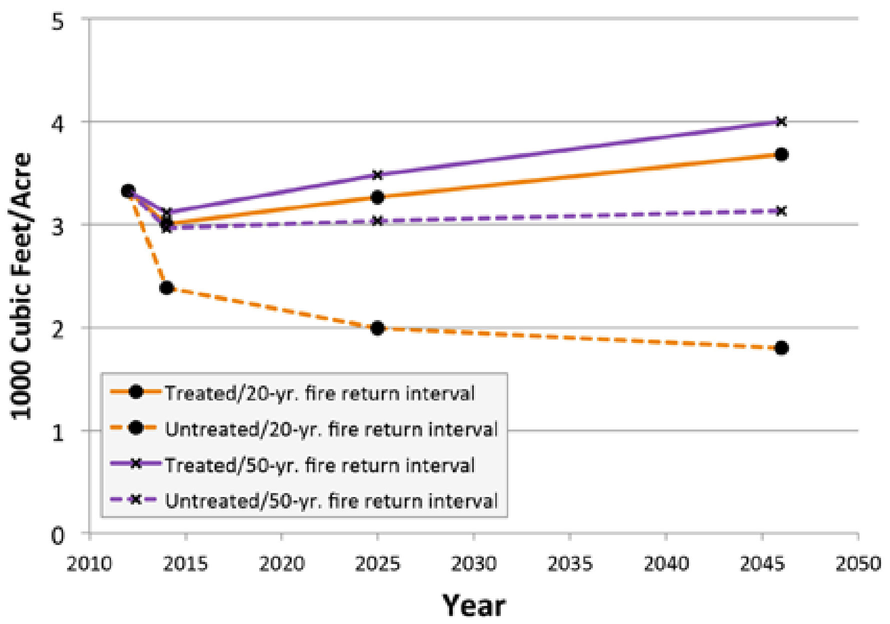

**Figure 3.**— *Mean merchantable volume of live and harvested trees in Douglas-fir and true fir stand of the dry mixed-conifer region, including climate effects of harvested wood expressed as volume, by whether treated and fire return interval.*

Without fire or treatment, average climate benefits are always greater over the 32-year projection period, owing to maintenance of higher forest carbon stocks. If fire occurs, climate benefits are greater in treated forests by the end of the projection period, regardless of fire timing.

Given that fire has long been an integral part of these forests, it is all but certain that a fire will occur at any particular location in the forest at some time in the future. There is, however, an uncertainty as to when fire will encounter that location. Therefore, we incorporated the probability of fire occurrence for a given mean fire return interval and used this to weight the combination of future carbon trajectories depicted in figure 2 for the no-treatment and best- treatment cases (figure 3).

> Evidence that fuels management may not be incompatible with producing climate benefits should lead to more informed choices about forest management.

For fire return intervals of 20 and 50 years, implementing the best treatment produces greater climate benefits than no treatment, considering in-forest carbon and out-of-forest product effects. Of course, climate benefits represent only one of many drivers of decisions about forest management. The evidence, however, that fuels management may not be incompatible with producing climate benefits should lead to more informed choices.

A couple of caveats should be noted. First, this analysis addresses only the stand-level benefits of fuel treatment in terms of the carbon and climate benefits that occur for a stand and the products that flow from that stand. Accounting for the landscape-scale benefits of a comprehensive and effective fuel treatment program, which could well reduce the size or frequency of large fires, could generate reductions in forest carbon emissions that we have not addressed here. Second, the prospect of climate benefits depends critically on the likelihood of fire encountering the treated area during the effective lifespan of the treatment. Because only a few of the 14 FVS variants used in this analysis include regeneration models by default, we consider these results preliminary.

Under the auspices of a 2013 Joint Fire Science Program grant, we are exploring techniques for modeling regeneration, which, especially following treatment or fire, could conceivably lead to rapid development of ladder fuels and increases in post-treatment forest volume, either one of which could alter these preliminary conclusions. We think, however, that the conceptual approach—of modeling fuel treatments and their effects on the FIA inventory plots under alternative scenarios—is a promising way to enhance statistical rigor in our understanding of the climate implications of fuel treatments.

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## Success Stories Wanted!

We’d like to know how your work has been going! Provide us with your success stories within the State fire program or from your individual fire department. Let us know how the State Fire Assistance (SFA), Volunteer Fire Assistance (VFA), the Federal Excess Personal Property (FEPP) program, or the Firefighter Property (FFP) program has benefited your community. Feature articles should be up to about 2,000 words in length; short items of up to 200 words.

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# Fire Season 2012: The Impact of Fuel Treatments on Wildfire Outcomes

Frankie Romero and James Menakis

## Introduction

The fuels and fire ecology program within the Forest Service Fire and Aviation Management (FAM) program is aimed at protecting people and property from experiencing harm by wildfire, while taking actions to improve forest conditions. Since 2001, the Forest Service has treated hazardous fuels on more than 26 million acres of National Forest System (NFS) lands across the country, almost 16 million of which are in the wildland-urban interface (WUI). In addition, the Forest Service supports grant programs to assist States and local jurisdictions to implement fuel reduction projects beyond NFS borders, resulting in an additional 3 million acres of fuel treatments outside national forest and grassland boundaries.

Implementing fuels treatments comes with both risks and costs. Any time we choose to manipulate vegetation—whether we use chainsaws, heavy equipment, herbicides, livestock, or prescribed fire—there is risk of experiencing undesirable consequences, such as injury to workers, unintended harm to plant and wildlife communities, smoke incursions, or damage to adjacent non-NFS property.

> In its simplest form, the FTEM process simply asks, "Did the fuel treatment alter fire behavior?" and "Did the fuel treatment help firefighters to control or manage the fire?"

The costs of treatment are also very clear and apparent; we know exactly what it costs to implement such projects (the Forest Service averages $30 to $200 per acre for prescribed fire and $250 to $1,000+ for mechanical fuels treatments). In contrast, the potential return from an investment in fuels treatment is more difficult to measure, not only because of the random nature of wildfire occurrence but also because the benefits—such as added safety, reduced risk, enhanced fire suppression effectiveness, and improved ecosystem function—are not easily translated into a dollar value that we can compare to our initial investment.

Because land managers strive to minimize the risks while maximizing the return on limited funds, we must ask ourselves: Are we getting a good return on our investment when we implement fuels treatments? Are the benefits we receive a good value or should we adjust to better balance the investment with the expected benefit?

### Monitoring the Effectiveness of Fuel Monitoring

In 2006, the Forest Service initiated a program of monitoring the effectiveness of fuel treatments to help answer some of these questions about the return on fuel treatment investments. When a wildfire starts within or burns into a fuel treatment, an assessment is conducted to evaluate the impacts on fire behavior and fire suppression actions that resulted from the fuel treatment.

The purpose of fuel treatment effectiveness monitoring (FTEM) is to determine:

1. Are fuel treatments affecting fire behavior by reducing the intensity and/or rate of spread?
2. Does suppression effectiveness improve through enhanced firefighter safety, reduced firefighting costs, and/or reduced potential fire damage?
3. What are the lessons learned that are important to help improve the hazardous fuels program?

In its simplest form, the FTEM process simply asks, "Did the fuel treatment alter fire behavior?" and "Did the fuel treatment help firefighters control or manage the fire?"

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When first initiated, individual forests could voluntarily enter information in the FTEM database, and the early results were of predominantly "successful" interactions. Starting in 2011, monitoring was made mandatory any time a fuel treatment encountered a wildfire on NFS lands. Mandatory monitoring resulted in the capture of those instances where fuel treatments were not effective in altering the wildfire outcome, which provides us with rich insight into how to improve the program. In 2012, the Forest Service made the FTEM database available to U.S. Department of the Interior agencies. In the course of monitoring these fuel treatment-wildfire interactions, we have found the opportunity to make observations and generalizations regarding the impact that fuels treatments have when tested by wildfires.

## Fuel Treatment-Wildfire Interactions Observed During the 2012 Fire Season

The FTEM database contains more than 300 records of fuel treatment-wildfire interactions on NFS lands for the 2012 fire season. About 90 percent of FTEM database records reported fuel treatments being effective in either changing the fire behavior of the wildfire as planned in the treatment objectives or helping with control or management of the wildfire. Because of reporting delays and the fact that multiple interactions often are recorded in a single database entry (one wildfire burns into several treatments), we believe these numbers are conservative for 2012 and that more than 300 separate and distinct interactions between fuel treatments and wildfire actually occurred on NFS lands.

While a rigorous scientific analysis of the impact of fuel treatments on wildfire outcomes is needed, national and regional fuel specialists who monitor these interactions have been able to detect recurring themes based on making personal observations in the field; viewing entries in the FTEM database; and reviewing the optional reports, photos, and maps that have been attached to some of the records in the FTEM database.

When wildfires encounter fuel treatments, we regularly observe that the fuel treatment led to one or more of the following outcomes:

- Improved initial attack success;
- Improved success in protecting homes and communities from wildfire;
- Reduced wildfire damage and improved forest resilience after wildfire; and
- Improved ability to provide wildfire managers options for minimizing risk, reducing costs, and enhancing fire-adapted ecosystems.

The following sections provide a selection of fuel treatment-wildfire interactions that illustrate individual instances of the impact that fuel treatments had on wildfire outcomes during the 2012 fire season.

## Fuel Treatments Improved Initial Attack Success

**Swain's Creek Fire, Dixie National Forest, Utah.** Local firefighters expected structure loss when this fire was reported on June 20, owing to "high" fire danger, proximity to structures, and large fire growth experienced in previous weeks throughout southern Utah. Once on scene, first responders determined that this human-caused fire was within the Duck Creek Fuels Project, which had been thinned, piled, and burned in 2008. The fire was on NFS land about 100 feet from private land and structures. Observed flame lengths were 6 to 8 inches, burning in ponderosa pine needle litter. The fuel treatment greatly reduced flame lengths, prevented torching and spotting, and allowed firefighters to easily contain and control the fire at 0.5 acres (figure 1).

**Figure 1.**—*Firefighters mopping up the Swain's Creek Fire with structure in the background, June 20, 2012. Source: Eric Eastep, Dixie National Forest.*

**Southeastern National Forests.** One notable observation is that the Southeast United States was in drought conditions for a large portion of last year, yet relatively few large wildfire events occurred there. In a query of the FTEM database, we found that, in 2012, 67 percent of the recorded wildfire-fuel treatment interactions for the national forests in the Southeast were from wildfires that were smaller than 20 acres in size. This was a slight reduction from 2011, where 75 percent of the interactions were from wildfires smaller than 20 acres. It is arguable that this is due to a variety of factors; however, there is a strong feeling among managers in the Southeast that their initial attack success is due in large part to the robust prescribed burning program in this region, which aims to treat most coastal plain forests every 3 years. In calendar year 2012, the Forest Service treated 695,122 acres with prescribed fire in its Southern Region compared to 85,820 acres burned by wildfire (Southern Area Coordination Center[1]).

## Fuel Treatments Improved Success in Protecting Homes and Communities From Wildfires

**Gladiator Fire, Prescott National Forest, Arizona.** The Gladiator Fire was detected on May 13 at approximately 10:45 a.m. The fire was human-caused and started on private land in the town of Crown King, AZ. The fire quickly grew to 500 acres, and a type 1 incident management team was assigned. On May 18, the area experienced red-flag conditions as the fire, now close to 10,000 acres, burned through chaparral with 20- to 30-foot flame lengths (figure 2). Crews prepared for a burnout operation along the "Senator Highway" (Forest Road 52) in an attempt to contain the northwest spread of the fire toward the Pine Flat subdivision. Fortunately, once the fire entered the Ash Creek Prescribed Fire area, a 2003 treatment (figure 3), the fire dropped in intensity and slowed dramatically, allowing the crews to contain the fire edge directly with less effort than if the burnout operation had been necessary.

**Figure 2.**—*Gladiator Fire exhibiting 20- to 30-foot flame lengths in decadent chaparral, May 18, 2012. Source: Fred Hernandez, Forest Service.*

**Figure 3.**—*Gladiator fire unable to sustain spread within the Ash Creek prescribed fire area, May 18, 2012. Source: Prescott Hotshots.*

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[1] Acres treated by prescribed fire and acres burned by wildfire were previously available on the Southern Area Coordination Center website. The website has since evolved and the figures are no longer available.

**Fontenelle Fire, Bridger-Teton National Forest, Wyoming.** The Fontenelle Fire started in a mixed-conifer forest on Sunday, June 24. Fire behavior included torching, crowning, and prolific spotting of up to ½ mile. By Sunday, July 1, the fire had grown to more than 45,000 acres, with more than 400 firefighters and support personnel on the scene—and more coming.

One area of concern for firefighters was the 12 summer homes in Middle Piney. Fortunately for homeowners and firefighters, a fuel treatment project around these summer homes had been implemented 10 years earlier; that treatment consisted of selective understory thinning to open the forest canopy, removal of ladder fuels that can cause crown fires, and removal of dead trees and other fuels around the homes. On Wednesday, June 27, additional structure protection work started around Middle Piney summer homes. The division supervisor at Middle Piney said that the hazardous fuel treatments "allowed for the structure protection process to go quicker than it would have and required fewer resources."

Around 2:30 p.m. on Sunday, July 1, fire crews started burnout operations near the Middle Piney summer homes as the Fontenelle Fire began moving down slope. By 8:00 p.m., the firefighters had successfully defended the Middle Piney summer homes (figure 4). The division supervisor at Middle Piney said, "These treatments helped firefighters protect the homes," and emphasized that the fuel treatments "absolutely" allowed for firefighter safety.

**Figure 4.**—*Middle Piney summer homes after Fontenelle Fire. The green trees surrounding the summer homes are located within the fuel treatment area. Source: Jim Menakis, Forest Service.*

**Pole Creek Fire, Deschutes National Forest, Oregon**. The Pole Creek Fire was started by lightning in the Three Sisters Wilderness near the Pole Creek Trailhead on September 9. The fire grew to approximately 1,500 acres the first day, and a cold front passage the following day pushed it to more than 3,000 acres. The fire was eventually controlled at 26,795 acres but posed a significant threat to Sisters, OR, and surrounding communities. Fire crews were able to take advantage of fuel treatment areas to conduct burnout operations that helped control the fire. The Forest Service Pacific Northwest Region and the Deschutes National Forest produced a video called *Make Wildland Urban Interface Communities Safer with Fuels Reduction* which tells the full story of the Pole Creek Fire's interaction with the Sisters Area Fuels Reduction Project; view the video at <http://www.youtube.com/watch?v=5YOYDK1Zv9s>.

About 90 percent of FTEM database records reported fuel treatments being effective in either changing the fire behavior of the wildfire as planned in the treatment objectives or helping with control or management of the wildfire.

## Fuel Treatments Reduced Wildfire Damage and Improved Forest Resilience to Wildfire

Fuels treatments were largely successful in reducing wildfire intensity, resulting in desirable post-wildfire effects including mosaic burn patterns, retention of seed banks, and retention of overstory cover, which is expected to allow for appropriate recovery of plant and wildlife populations after wildfire.

**Camp V (five) Fire, Nebraska National Forest, Nebraska.** On June 30, 2012, the Camp V Fire entered the Bessey Fuels Treatment Area, where thinning had been complet-

**Figure 5.**—*Aerial photo of Camp V (five) Fire post-fire effects where fuel treatments altered fire intensity allowing for control (a) as well as reduced damage to pine (b) and cedar (c) plantations. Source: Thomas County Sheriff's Department, Nebraska.*

ed in 2007 and prescribed burning in 2009 and 2010 (figure 5). Drought conditions were prevalent, and the Governor of Nebraska had declared a state of emergency to address the continuing fire problem in the State. In taking action on the Camp V Fire, the fuel treatments were used as a control feature to burn out along a road where fuels had been removed to control the fire. In evaluating the post-fire effects, the district ranger observed that, "We were really lucky on this one…. It burned through an area that we had thinned, and recently [had] done a prescribed burn…." The fire "stayed on the ground and out of the canopy in a lot of places," he said, which helped most of the hand-planted trees to survive the fire (Starhearld.com 2012).

**Central Idaho Large Fires.** Three large fires in central Idaho covered a combined area of more than 662,000 acres—the Holstead Fire (179,557 acres) and the Mustang Complex (336,028 acres) on the Salmon-Challis National Forest and the Trinity Fire (146,741 acres) on the Boise National Forest. Within the footprint of these wildfires, thousands of acres of fuel treatments were encountered. While the size of the treatments was dwarfed by the scale of these wildfires, the immediate post-fire effects indicate that fire intensity was reduced within the treated areas, which served to limit damage caused by the wildfires. The Burned Area Reflectance Classification images shown in figures 6 and 7 illustrate where fire intensity was reduced within areas where fuels had been treated within the footprint of these especially large wildfires.

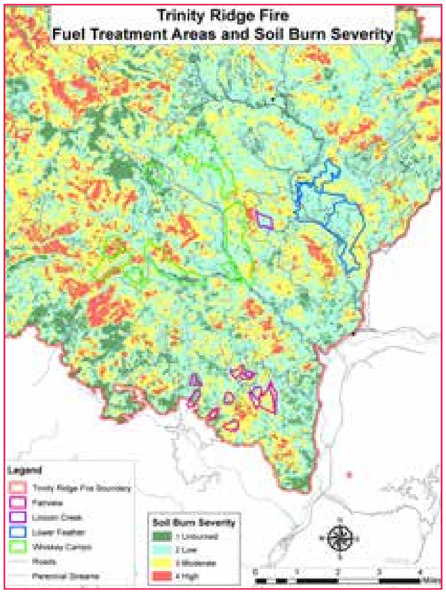

**Figure 6.**—*Portion of the Trinity Ridge Fire severity map showing where fire intensities were generally reduced where fuel treatment had occurred. Note: Some of the Whiskey Campo units had mechanical treatment completed, but follow-up prescribed fire treatment had not occurred when wildfire hit contributing to higher intensities in some units.*

**Barry Point Fire, Fremont-Winema National Forest and Modoc National Forest, Oregon-California Border.** The Barry Point Fire started by lightning on August 5 in south- central Oregon; this fire burned 93,000 acres over the course of 16 days before it was contained by suppression actions and moderating weather.

The Fremont-Winema and Modoc National Forests have conducted fuel reduction projects on thousands of acres within the Barry Point Fire area over the past 20 years. In general, fuel reduction treatments in anticipation of an eventual fire have two broad purposes in this area: reduce fire intensity (increase stand survival) and facilitate safe suppression and

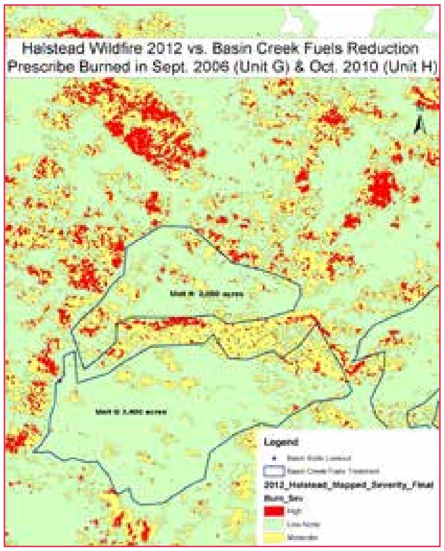

**Figure 7.**—*A portion of the Halstead Fire, where fuels reduction treatment resulted in reduced fire intensity as the larger wildfire burned around these treatment areas.*

**Figure 8.**—*Kellogg Unit 5, effect of understory thinning and prescribed burning (2010) in center and left side of photo, adjacent forested lands on right side with much higher stand mortality where surface and ladder fuels were not treated. Kellogg Unit 5 was also used as a roadside fuel break to contain the west side of the fire on the Modoc National Forest. Source: Jim Menakis, Forest Service.*

containment of wildfire. Lower than expected fire intensities were observed within the fuel treatment areas where trees had been thinned from below, canopy base height was increased, and surface fuels had been treated with prescribed fire.

In contrast, past treatments on adjacent forested lands had focused on commodity production, with little consideration of potential wildfire impacts; such a focus resulted in small-diameter, dense stands with close crowns, low-crown base heights, and extensive surface fuel accumulations. Higher fire intensity was observed in these dense stands during the Barry Point Fire and, as a result, the fire caused more damage to the overstory trees on these forested lands than it did within the fuel treatment areas (figure 8 and 9).

## Fuel Treatments Provided Wildfire Managers Options for Minimizing Risk, Reducing Costs, and Enhancing Fire-Adapted Ecosystems

**Elbow Pass Complex, Bob Marshall Wilderness Complex, Montana.** In 2003, the High Fire on the Flathead National Forest, just west of the Continental Divide and Lewis and Clark National Forest, burned a mere 122 acres but required more than $400,000 and significant exposure of personnel and aircraft to control. Although the High Fire was well within the Bob Marshall Wilderness complex, suppression action was deemed appropriate because of the threat of its leaving the wilderness area and affecting the Benchmark Recreation Corridor and private lands to the east. Within a 20-square-mile area of where the High Fire occurred, 19 fires had started over the past 20 years, indicating to managers that it was inevitable that one would eventually escape the wilderness area.

Knowing this area would be a continual challenge for them, local managers had crafted a plan to proactively reduce the cost and exposure to firefighters in the future while also allowing fire to play its role in wilderness. Previous wildfires and rugged terrain with areas of sparse vegetation offered a land-

> We saw hundreds of instances where fuel treatments offered firefighters environments where suppression efforts could be more successful and safer.

**Figure 9.**—*Adjacent forested lands with much higher stand mortality next to Kellogg Unit 5 on the Modoc National Forest. Source Jim Menakis, Forest Service.*

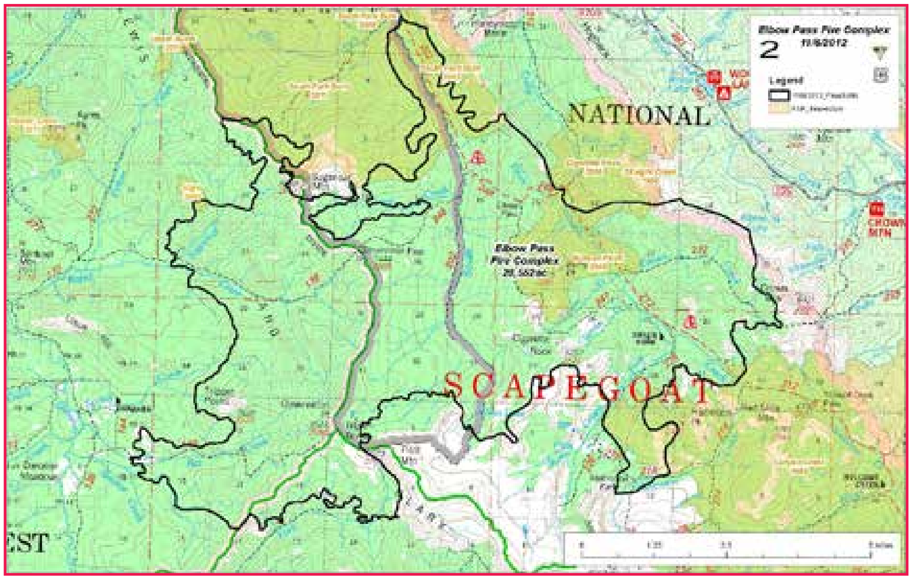

**Figure 10.**—*Elbow Pass Complex in relation to previous wildfires and the recent South Fork Prescribed Burn units, which limited spread to the north. Source: Lewis and Clark National Forest.*

scape with opportunities to interrupt wildfire spread. Local managers planned and ignited a series of prescribed fires between 2003 and 2011 to introduce fire back into the landscape in an effort to break up the continuous fuels and reduce the chances of fire escaping the wilderness area. Completing the South Fork Sun Prescribed Fires "put the cork in the bottle," as the local fire management officer described it.

From July 12 through July 31, five different lightning fires ignited, eventually merging into the Elbow Pass Complex. The South Fork Sun Prescribed Fires effectively stopped the Elbow Pass Fire's spread to the north (figure 10), allowing managers to focus actions on small pockets between the rock escarpments, previous wildfires, and prescribed fire areas. Managers observed that the Elbow Pass Complex was contained within wilderness with less effort and cost than had been expended in past years, owing in large part to the strategic placement of prescribed fires. By way of comparison, the 2007 Ahorn Fire in the Bob Marshall Wilderness was 52,505 acres in size and cost an estimated $377 per acre to manage, with large expenditures in aircraft, crews, and equipment, whereas the Elbow Pass Complex was 28,552 acres in size and cost an estimated $155 per acre to manage (Buhl 2012).

**Wesley Fire, Payette National Forest, Idaho.** After escaping initial attack on September 9, the Wesley Fire continued its march to the northeast until it ran into the headwaters of Rapid River, where prescribed burning had been accomplished over the past 15+ years. Considering an historical wildfire (Curren Fire, 1989), the Rapid River prescribed fires (1995–2009), and the topography (which was not well aligned with predominant winds), managers felt confident that the head of the fire would have a difficult time growing even under the persistent dry conditions that were dominating the weather forecast. This allowed them to choose a strategy where they would control the portion of the fire outside the Rapid River drainage, about 70 percent of the then 15,289-acre fire, but would not pursue the fire in Rapid River. This strategy was expected to reduce both costs and firefighter exposure. Once control lines were completed around the portion of the fire outside Rapid River, the management organization was reduced on September 30 from a type I incident management team (IMT1), with more than 600 personnel assigned and average daily cost of about $720,000, to a type III team (IMT3) with about 200 personnel and average daily cost of about $260,000 (Parker 2012). Using these average daily costs and a conservative estimate of 3 additional days for an IMT1 to directly control the fire in Rapid River, we estimate that the decision to not pursue the fire in Rapid River resulted in a cost savings of around $1,380,000 (IMT1 cost/day x 3 days – IMT3 cost/day x 3 days).

> While 90 percent of the fuel treatment-fire interactions reported these positive outcomes, the remaining 10 percent do not appear to have worked as intended, thus we need to examine those more closely to learn why that was.

The fire in Rapid River was monitored from September 23 to October 15 and grew an additional 821 acres before rain and snow stopped the Wesley Fire at 16,010 acres (figure 11). Most of those additional acres within Rapid River were moderate to low intensity as the fire backed downhill, mostly

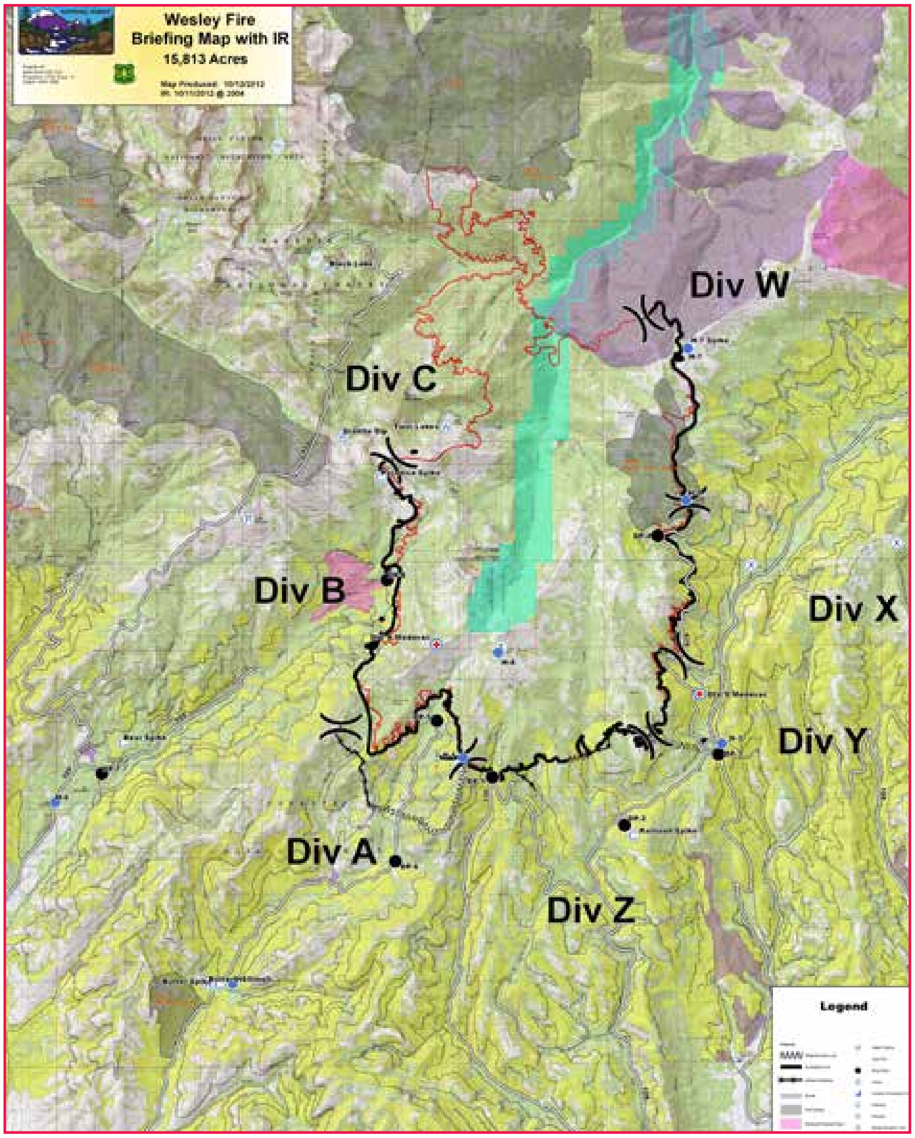

**Figure 11.**—*2012 Wesley Fire, where direct fire suppression was taken on most of the fire except the portion to the north in the Rapid River drainage, which was only monitored because fire spread potential was judged to be low given the time of year (October) and the barriers to fire spread, including prescribed fire treatments.*

burning ground fuels with only isolated torching—exactly the type of fire behavior managers envisioned for the land management goals in this area, which are largely aimed at reintroducing fire into this fire-adapted ecosystem.

## Room To Improve: More Observations From the 2012 Fire Season

Like any "after-action review," we need to consider what went well so that we can repeat it, but we also need to highlight where we can improve. The following are some observations from the 2012 fire season that may help us improve in the years to come.

### Find a Better Measure Than Acres Burned for Describing Wildfire Outcomes

As in the past, the story of the 2012 fire season is told in terms of number of fires and acres burned. A typical summary reads like this: *"Some 67,000 wildfires burned 9 million acres, which is fewer fires but more acres burned than the historical average."* When we summarize a fire season this way, the underlying assumption is that all of those acres were "damaging," which means the only way to be successful is to reduce acreage burned. Our understanding of fire's essential role in restoring and maintaining ecosystems, however, recognizes that many of our ecosystems suffer from a lack of fire and that often the health of the system is improved when fire is reintroduced. Therefore, shouldn't our definition of success include a description of how much of the "right kind of fire" we experienced as well as what damages or losses were incurred? Acreage burned is easy to measure, but it doesn't tell enough about the end result to be a useful measure of how effective we were in applying fuel treatments, management strategies, or fireline tactics to produce better outcomes.

As in previous years, the characterization of the 2012 fire season has fallen short of describing the favorable outcomes, by describing only the bad, which in turn prevents us from describing the impact that management actions had on producing better wildfire outcomes. Certainly there were wildfires in 2012 that caused damage to property and resources, and that even resulted in the tragic loss of life. But in many cases, wildfires also enhanced or maintained resource conditions and even added a measure of protection by reducing fuel accumulations and breaking-up fuel continuity. In 2012, we observed cases where fuel treatments, wildfire management strategies, and thoughtful fire suppression tactics, either individually or in combination, resulted in fire behavior that moved some areas affected by wildfire toward more desirable conditions (that is, healthier forests and reduced fuel loadings). In the future, we hope to improve our portrayal of wildfire outcomes by finding metrics that better describe this net effect.

So, what might success look like if we were to better illustrate wildfire outcomes? First, we will need to describe individual fires not just by acreage burned, but in terms of actual outcomes, characterizing the damage caused as well as apparent gains or improvements. If we can take that step, then it is not hard to imagine a summary of some future fire season that reads more like this: *"About 75,000 wildfires burned this year covering 8 million acres, with 2 million acres experiencing severe damage, 4 million experiencing light to moderate damage, and 2 million acres that were largely beneficial where fire removed dead and dying vegetation and created healthier forest conditions for the future. This year represents an improvement over previous years because the proportion of severely damaged acres trended downward while acreage of improved forest conditions after a wildfire is trending upward."*

> The return on these investments is not just in dollars but also in the currency of safety, protection from risk, and ecosystem function.

## Make Fuel Treatment Information Readily Available During Incidents

After completing the planning, doing the ground work, the areas we treated are in a better condition to offer options to managers and firefighters when wildfires happen. But a recurring observation made this year was that we were not always prepared to put this information into the hands of decisionmakers and firefighters when a wildfire started. Time and again, we found that the spatial information on fuel treatments resides on a personal computer, specialist's workspace, or external hard-drive, causing delays in locating, transferring, and making it available to incident personnel. Line officers and incident commanders attended public meetings all across the country to describe the firefighting strategies being used on wildfires in 2012. In those meetings, how many included the locations of fuel treatments in relation to the wildfire on their incident situation maps? How many opportunities did we miss to describe the value of the investments we made that are now providing opportunities to managers and firefighters taking action on a wildfire?

Putting fuel treatment information into the hands of decisionmakers and firefighters in a timely fashion can result in better management decisions as well as safer and more effective firefighting. But to make this happen, we need to spend the time in the pre-season to prepare. For Federal agencies or others using the Wildland Fire Decision Support System (WFDSS), the most obvious solution is to insert this information into the pre-load information within WFDSS. In the future, we hope to see an automated process for creating a fuel treatment data layer in WFDSS using national data sources, but at present the most reliable source for such data is the local unit. Once a local unit loads its fuel treatment information into WFDSS, it becomes easily accessible to managers and incident management teams when a wildfire occurs. For more information on how to load fuel treatment data into WFDSS, go to <http://wfdss.usgs.gov/wfdss/pdfs/Decision_Fuel_Treatments.pdf>; to get help from the Wildland Fire Management Research, Development and Application (WFRD&A) staff, go to <http://www.wfmrda.nwcg.gov/>.

## Summary

From the observations made during the 2012 fire season, we can conclude that the fuels management program did influence wildfire outcomes. We saw hundreds of instances where fuel treatments offered firefighters environments where suppression efforts could be more successful and safer. There is evidence of reduced fire intensity within fuel treatment areas where the prospects for renewal are now better because of proactive fuel treatments. We saw instances where managers were able to use wildfire strategies that reduced suppression costs and reduced exposure to firefighters. We saw numerous cases where wildfires would have grown larger and potentially more damaging had firefighters not had fuel treatments already in place.

In some cases, fuel treatments did not significantly influence the final fire size of the largest wildfires; however, even in these extreme examples, fuel treatments were effective in helping firefighters to limit the damage caused by wildfires while also improving the resilience of the forest.

While 90 percent of the fuel treatment-fire interactions reported these positive outcomes, the remaining 10 percent do not appear to have worked as intended, thus, we need to examine those more closely to learn why that was. Are fuel treatments a good investment? We will need better analyses to answer that question quantitatively so that we can clearly state how much treatment, in which areas, and at which intervals could provide the highest return for each dollar invested. This work is ongoing, and we expect to see the science in this arena continue to advance. The return on these investments is not just in dollars but also in safety, protection from risk, and ecosystem function. This means the answer is more complicated than seeking a financial return, because society has not given science a dollar-value equivalent for these nonmonetary returns. While science grapples with quantifying this problem, the anecdotal evidence suggest that well-designed fuel treatments have a good chance of bringing about better wildfire outcomes, making fuels management an important part of an overall fire management strategy.

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## Contributors Wanted!

*Fire Management Today* is a source of information on all aspects of fire behavior and management at Federal, State, tribal, county, and local levels. Has there been a change in the way you work? New equipment or tools? New partnerships or programs? To keep up the communication, we need your fire-related articles and photographs! Feature articles should be up to about 2,000 words in length. We also need short items of up to 200 words. Subjects of articles published in *Fire Management Today* may include:

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Planning (including budgeting)
Preparedness
Prevention/Education
Safety
Suppression
Training
Weather
Wildland-urban interface

# A TOWERING FEPP PROGRAM SUCCESS: TRAILER TRUCK PROVIDES FIRE TRAINING ACADEMY ENVIRONMENT FOR NORTHERN MINNESOTA'S CLOQUET AREA FIRE DISTRICT

Kevin Schroeder

In the fall of 2011, the Cloquet Area Fire District (CAFD) in Minnesota acquired a semitractor trailer truck through the Federal Excess Personal Property (FEPP) program. The truck transports a 53-foot, propane-fired mobile live fire training trailer and a mobile training tower (figure 1). The mobile training tower is the only one of its kind in Minnesota and 1 of only 10 units nationwide.

The newly acquired truck enables CAFD to transport these units to each of the district's three stations and throughout the entire region and the State for onsite training. The live fire training trailer was featured at the Fire Service Educators Professional Development Conference and the Minnesota State Fire Chiefs Association Conference in 2012.

The acquisition cost through the FEPP program was $1,500, and the district needed about $5,000 to put the vehicle into service. Upgrades included tires, paint, striping, and mechanical work. The CAFD staff used existing equipment to install the emergency lighting and siren.

The Mobile Training Tower is the only one of its kind in Minnesota and one of only 10 units nationwide.

The training trailer and tower enable the CAFD to provide a fire training academy environment for all aspects of basic and advanced firefighter training, including fire attack, search and rescue, self-contained breathing apparatus confidence, firefighter self-rescue, wall breaching, forcible entry, vertical and horizontal ventilation, rapid intervention, and confined space rescue (figure 2). This resource was not available in the region before this project.

The ability to train in the home environment enables 100 percent of fire staff to be included without the need to travel long distances; it also provides training opportunities at a much lower training cost to participating fire departments. This access, along with the variability of potential training scenarios, enables firefighters to obtain repetitive practice to learn and hone their skills in a safe and controlled environment.

The live fire training unit is the newest in Minnesota and the only unit in northern Minnesota capable of supporting three independently controlled propane-fired burn props simultaneously on multiple levels. The two-story unit, with computer-

**Figure 1.**—*CAFD Mobile Live Fire Training Trailer and Federal Excess Personal Property.*

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*Kevin Schroeder is the district fire chief for the Cloquet Area Fire District, Cloquet, MN.*

**Figure 2.**—*CAFD firefighters enter the training trailer to attack an interior fire.*

controlled burn props and integrated safety systems, meets all national safety codes and offers complete push-button control of the training environment. In addition, the unit can be set up and operated in any location owing to the clean-burning nature of the propane-fueled fire system (figure 3).

The training trailer and tower enable the CAFD to provide a fire training academy environment for all aspects of basic and advanced firefighter training.

This mobility is not possible with some of the older fire trainers that still use class A fuels for training. In class A trailers, the instructor does not have complete control of the training environment, and the products of combustion produced during training evolutions can cause issues when located in residential areas.

The CAFD has received inquiries from as far away as 170 miles. The CAFD uses the trailer weekly during the spring, summer, and fall, and transports it with the FEPP vehicle to other locations 15 to 20 times a year. The units are available to any department in the region for the cost of the operator, fuel, and expendables.

The CAFD's fire department, which has a combination of 24 full-time staff and 34 volunteers, operates out of three stations (the city of Cloquet, the city of Scanlon, and Perch Lake Township). The department provides firefighting and emergency medical services (EMS) transport at the advanced life-support level and responds to 2,800 incidents each year in an area of 270 square miles. The CAFD serves a permanent population of 14,200; the stations also provide fire and EMS coverage to areas outside the district, serving a total population of more than 22,000, including the Fond du Lac Band of Lake Superior Chippewa throughout their reservation lands. ■

**Figure 3.**—*CAFD truck and trailers at a Minnesota State Sectional Fire School.*

# TRAINING FUTURE FIRE MANAGERS: INNOVATIVE PARTNERSHIP EXPANDS JOB CORPS IMPACT

Michaela Hall

The Forest Service Fire and Aviation Management (FAM) program and the Job Corps Civilian Conservation Centers (JCCCC) have formed an innovative partnership to expand the influence of the Job Corps program in filling future fire management positions in the Forest Service. At the beginning of fiscal year (FY) 2013, this partnership phased in a new fire program to establish and/or formalize type 2 wildland fire crew and camp crew programs at each of our 28 JCCCCs over the next 5 years.

Upon successful completion of the JCCCC Fire Program requirements, Job Corps students will have the opportunity to compete for permanent or seasonal appointments or be hired under the Public Lands Corps authority. Students may be recruited as apprentices for the Wildland Fire Apprentice Program, which will be one of the training programs for new firefighter hires to better meet the demands for a professional, highly skilled, and diverse wildland fire management workforce.

A number of JCCCCs have provided fire and camp crew support for many years, thanks to grassroots efforts at the local forest and center level. In 2012, 18 of the 28 JCCCCs trained and certified more than 750 students as firefighters, camp crew members, and administrative support staff. These students responded to approximately 100 wildfire incidents and also provided hurricane and storm recovery support. The partnership between FAM and the JCCCCs will provide support for centers with existing fire programs and establish new programs on the remaining centers.

The Forest Service has operated Job Corps Civilian Conservation Centers since 1964.

The Forest Service has operated JCCCCs since 1964. During this time, the Forest Service has trained eligible youth, between the ages of 16 and 24, and provided them with the educational, social, and vocational skills to assist in the conservation of the Nation's public natural resources. At any time, more than 5,000 students are enrolled in the Forest Service's 28 centers.

As documented by Dawson and Bennett, "Dating back to the Civilian Conservation Corps of the 1930s, the Forest Service has a history of involvement with employment programs with a rich legacy of land stewardship" (2011). Today, JCCCCs are continuing the tradition of protecting America's natural

*Crew Boss John Fry instructs two Harpers Ferry Job Corp students in firing operations on the Cheat Summit Fort prescribed burn on the Monongahela National Forest, the first year of the Monongahela fire team program (Spring 2009).*

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*Michaela Hall completed the Job Corps program in 2007 after securing a permanent position with the Forest Service. She is the Job Corps Program Specialist within Fire and Aviation Management in the Forest Service national office.*

heritage and providing programs of work-based learning to conserve, develop, manage, and enhance public natural resources.

Although JCCCC students "are enlisted in a diverse array of Forest Service programs," noted Dawson and Bennett, "they are most widely known for their program contributions in urban forestry, hazardous fuels reduction, construction, and firefighting."

"Job Corps is a program of opportunity…," the authors continued. "Most students come from low-income communities, both urban and rural, and are seeking pathways to prosperity."

Upon completion of Fire Program requirements, students will have the opportunity to compete for permanent or seasonal appointments.

Furthermore, according to Dawson and Bennett (2011), JCCCC students "are a diverse snapshot of our Nation that reaches across the spectrum of race, gender, and ethnicity. They are the citizens [who] are, all too often, missing from our national conversations about the environment…. After completing training, Job Corps graduates return to their communities as productive workers, consumers, community leaders, and entrepreneurs." Through the fire program, the Forest Service can continue to take advantage of the available resources at JCCCCs, demonstrate its commitment to meeting the Cultural Transformation goals for the agency's workforce, and employ our Nation's youth.

*March 2012 training session at the Stephen T. Mather training center located at the Harpers Ferry National Park. Thirty Job Corp students, five AmeriCorps members, and five Monongahela National Forest employees attended the session.*

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Job Corps has 124 centers nationwide. For more information about Job Corps, visit your local Job Corps center, call 800-733-JOBS, or visit Job Corps' Web site at <http://www.jobcorps.gov>.

For more information on Forest Service JCCCCs, contact:

Job Corps National Office
Forest Service
740 Simms Street
Denver, CO 80401
Phone 303-275-5920
http://www.fs.usda.gov

# PROPOSED PROCESS FOR ANALYZING COURSES FOR CONVERSION FROM INSTRUCTOR-LED TO ONLINE OR BLENDED LEARNING

Mark L. Cantrell

If your goal is to take an instructor-led vocational course and convert it for Web-based training (WBT), it will work best if you view it as a completely new course creation. This is not to say that a current, instructor-led training (ILT) course will not be of value; it will be of tremendous value. The analysis plan, however, is best accomplished without the restriction of what the current ILT course is.

Initially, this may seem like an unnecessary step backwards. However, it has been the experience of NWCG Training—the training branch for the U.S. wildland firefighting force organized under the National Wildfire Coordinating Group (NWCG)—that this is the most beneficial approach to take. Many NWCG Training courses have a hands-on element that makes the blended format the most common for our conversion efforts.

Using NWCG Training as an example, this paper outlines a process for achieving a successful conversion of a vocation-technical training course to blended environments.

## Background

NWCG Training has been steadily striving to bring the right training to the right people at the right time (Singh 2003). Since 2007, the program has been slowly converting select courses from an instructor-led format to a blended learning format, in which the course is divided into two portions: 20 to 24 hours of online or WBT followed by ILT. Generally, what was a 40-hour instructor-led course converts to 20 to 24 hours online and an 8-hour instructor-led field day. After developing this model for the past 5 years, it has proven to be a viable model for converting vocational training.

Many organizations are striving to convert existing instructor-led courses to online or blended learning environments.

The NWCG Training foundational model seeks to emulate a *tell–show–do* mentality. The performance-based NWCG Training system focuses on safety, which creates a priority for training that can immediately be used in real-world, high-risk situations. The realization that a person could be entering a potentially dangerous environment provides inherent motivation throughout the entire process. This intrinsic motivation to pay attention to the content brings safety to the forefront of not only the student's mind but the instructional designer's mind as well.

When a course is structured with real-world, on-the-job application in mind, the *tell–show–do* mentality is very beneficial. Baggett stresses, "…the importance of ensuring that individuals feel that the course is directly relevant to their needs and job responsibilities will influence participation and completion of the WBT modules" (Baggett 2012, p. 42). NWCG Training begins by telling them how they will use a skill on the job in the position for which the course is helping them qualify.

The normal NWCG Training blended course follows the WBT portion with an ILT field day to "prove" competency. The WBT presents and fully explains the skill and then demonstrates the information for the student to watch. In the blended learning courses, these two steps often occur online; in a WBT environment students can interact with the description and then watch numerous videos of good and bad examples. A key part

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of the description is how they will be evaluated on this skill at the ILT field day.

With this background information in mind, the following research-supported analysis process is proposed for converting a 100-percent ILT vocational-technical training course into a blended course.

The analysis needs to evaluate learning by multiple perspectives, which will provide the information necessary to structure the course in such a way that safety is maximized while efficiency is gained. The multiple perspectives are:

1. Audience analysis,
2. Job analysis,
3. Task analysis,
4. Reusable learning object classification,
5. Task division,
6. Review of existing ILT course for currency,
7. Gap analysis, and
8. Transition to design.

## Audience Analysis

Audience analysis is important to help determine what knowledge (mental), skills (physical abilities), and attitudes (emotional priorities) prospective students should possess when they start the course. Clark and Harrelson in their 2002 research write "Transfer of learning is more likely when new knowledge and skills are acquired in their context of application." It is easier to establish this context when you understand what knowledge, skills, and abilities the audience enters the classroom door (virtual or literal) with on day one.

Generally, when you are converting a current ILT course, you will have a good idea about the incoming students and their abilities. Still, the normal audience analysis questions—such as (1) What qualifications, if any, does the student already possess? (2) What type of experiences can they relate to? and (3) How does the student expect to use the new knowledge and skills?—need to be addressed, in addition to any unique information or skill sets that would be helpful for the instructional designer to know.

At NWCG Training, when a course comes up for revision, a team is assigned to do the analysis. The team normally consists of one project leader, one instructional designer, one technical editor, and one media specialist. This team consults subject matter experts and feedback from the ILT course to determine if the identified incoming student skillset and knowledge base is sufficient or if it needs further investigation. Once this information is confirmed, the team then proceeds with the analysis. Upon completion of a solid audience analysis, a thorough job analysis is the next step.

## Job Analysis

Job analysis entails asking what a person successfully performing in this position needs to know and do. From an instructional designer perspective, when consulting with a group on course development, it is helpful to ask what a graduate of the course-to-be must know, value, and be able to do.

The focus should be on what they **must** know in order to be successful—with successful performance defined as **safely** meeting or exceeding job standards. The goal is to train employees for what they will actually do. This training is best done by observing exemplary performers. If it is not possible to directly observe job performance, then interviewing a diverse selection of subject matter experts is an alternative.

It might be tempting to take the current ILT course and assume everything that needs to be taught is in it, but this assumption could be misleading. Often, with an ILT course, instructors supplement content without realizing that they are filling in a gap in the instruction. A fresh job analysis will identify changes in procedures and policy that may have occurred since the course was designed.

Implementing a *learn-what-you-need-to-perform* mentality has caused a shift in how NWCG Training approaches online assessments. An accurate job analysis will be extremely useful in preparing the final assessment(s), for both the WBT portion and the ILT field day. NWCG Training normally has a final assessment for the online portion and another practical assessment for the field day. In order to enter the ILT portion of a course, each student must first pass the WBT portion, which includes a final assessment. When students pass that final assessment, they have to present it to the lead ILT instructor, in essence validating that they know the information that was presented and are ready for the practical portion.

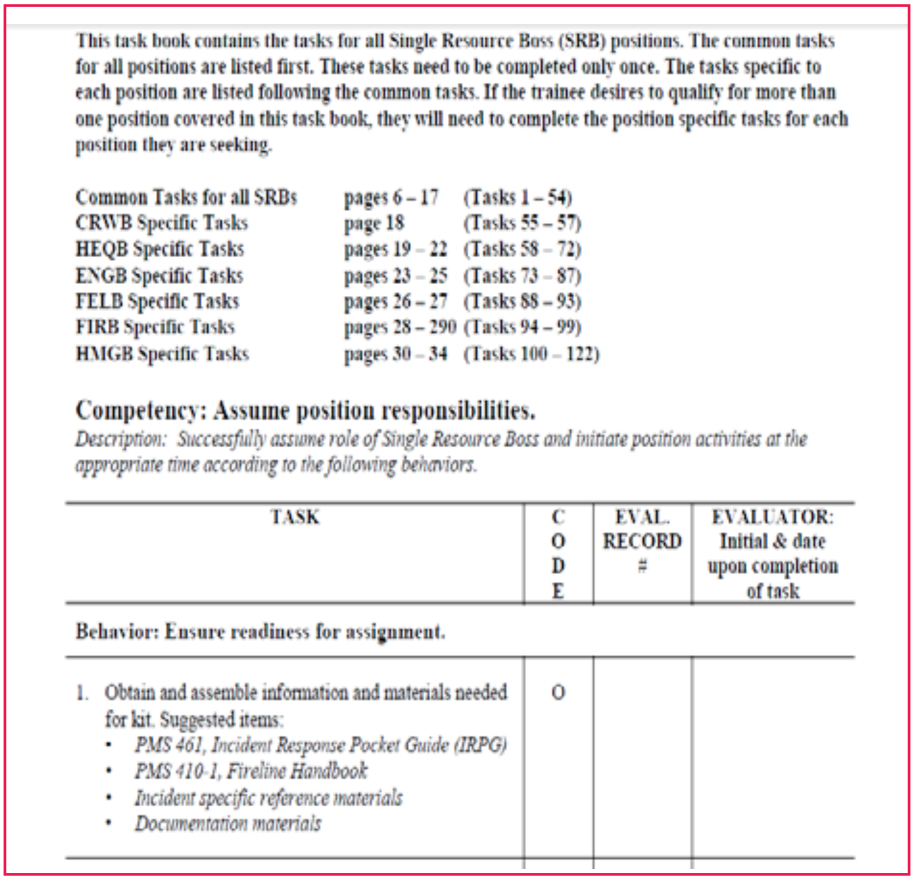
> The job analysis should help define the knowledge a successful performer needs, the attitudes the performer should possess, and the skills he or she should be able to safely demonstrate.

Ross comments on this mindset that, “Online assessment demands a different approach to gauging knowledge acquired. Creditability and accountability have shifted to the learner” (Ross 2001, p. 16). The research of Singh and Reed also supports this two-assessment mindset for “an online, web-based post-test that certifies the competency of new employees” (Singh and Reed 2001, p. 4). If someone does not know the information from the online portion, then the ILT instructor has the authority to tell the person that it is not safe to progress to the ILT portion until the WBT portion has been mastered.

## Task Analysis

The task analysis should provide a solid foundation for creating a learning path. The task analysis should use the information from the job analysis to create a list of tasks to be performed in the new position. Each task should consist of measurable steps that can be demonstrated for an evaluator. NWCG has established position task books (PTBs) for the Incident Command System wildland firefighting positions. These PTBs break the positions down into the format of competency, behavior, task, and examples. Figure 1 shows the first competency, behavior, and task for all single resource boss positions.

The end result of the task analysis process should be a learning path that demonstrates how to advance from position A to position B. This learning path should provide a clearly understood progression of skillsets, knowledge, and attitudes that outline what a person needs to learn in order to successfully perform in position B.



This task book contains the tasks for all Single Resource Boss (SRB) positions. The common tasks for all positions are listed first. These tasks need to be completed only once. The tasks specific to each position are listed following the common tasks. If the trainee desires to qualify for more than one position covered in this task book, they will need to complete the position specific tasks for each position they are seeking.

| | | |
|---|---|---|
| Common Tasks for all SRBs | pages 6 – 17 | (Tasks 1 – 54) |
| CRWB Specific Tasks | page 18 | (Tasks 55 – 57) |
| HEQB Specific Tasks | pages 19 – 22 | (Tasks 58 – 72) |
| ENGB Specific Tasks | pages 23 – 25 | (Tasks 73 – 87) |
| FELB Specific Tasks | pages 26 – 27 | (Tasks 88 – 93) |
| FIRB Specific Tasks | pages 28 – 290 | (Tasks 94 – 99) |
| HMGB Specific Tasks | pages 30 – 34 | (Tasks 100 – 122) |

**Competency: Assume position responsibilities.**

*Description: Successfully assume role of Single Resource Boss and initiate position activities at the appropriate time according to the following behaviors.*

| TASK | CODE | EVAL. RECORD # | EVALUATOR: Initial & date upon completion of task |
|---|---|---|---|
| **Behavior: Ensure readiness for assignment.** | | | |
| 1. Obtain and assemble information and materials needed for kit. Suggested items:<br>• *PMS 461, Incident Response Pocket Guide (IRPG)*<br>• *PMS 410-1, Fireline Handbook*<br>• *Incident specific reference materials*<br>• *Documentation materials* | O | | |

**Figure 1.**—*National Wildfire Coordinating Group Position task book excerpt for single resource boss positions.*

## Reusable Learning Object

If you have a learning content management system or desire to establish a content management system that is customizable, then each task should be evaluated for reusability. Consider whether each task is independent and reusable. Maddocks (2002) detailed the reusable learning object (RLO) concept in a study for Cisco Systems. Cisco has successfully used the RLO concept, and NWCG Training is striving to emulate their success by documenting the context and complexity of reusability. This step is valuable to NWCG Training from a learning content management system (LCMS) viewpoint. A LCMS is valuable from a number of perspectives, one of the most important of which is the ability to use the same information multiple times without having to recreate the information each time. Mohanty and Jain expand on the reusable learning object concept: “Learning objects are much smaller units of learning, typically ranging from 2 minutes to 15 minutes. They are small or elementary instructional components which are reusable in different learning contexts” (Mohanty and Jain 2009, p. 32). Understanding the RLO concept helps an instructional designer determine what type of learning can be expected from a particular task.

## Task Division

Divide all tasks or RLOs into environmental learning or foundational (near and far) learning by using the learning path as a guide. This concept builds on Van Tiems’s (2012) work on performance support. Application of his “Be Systematic”

# National Wildfire Coordinating Group Training

Training information can be found on the National Wildfire Coordinating Group (NWCG) Web site (<http://training.nwcg.gov/index.html>).

**Online Courses** (<http://training.nwcg.gov/courses.html>): Online Courses are completed without the need to attend a classroom session or a field day with the assistance of a course administrator. Certificates are received at the completion of the training sessions. For instructions and information about the specific training requirements that must be met prior to taking these courses, visit the NWCG Web site.

"I" Incident Command System
- I-100 Introduction to the Incident Command System (2006)

"S" Suppression
- S-110 Basic Wildland Suppression Orientation (2003)
- S-190 Introduction to Wildland Fire Behavior (2006)
- S-260 Interagency Incident Business Management (2011)
- S-290 Intermediate Wildland Fire Behavior (2010)

Other
- Firefighter Math
- Investigating Railroad Caused Wildfires
- Mountain Flying Training 2013
- Using the Fire Incident Mapping Tool (FIMT) Tutorial

**Blended Courses** (http://training.nwcg.gov/blended.html): Blended learning combines online training and instructor led training. The online component of the course must be completed prior to attending the instructor led portion of the course. All online courses require the use of a course administrator. A course administrator must be secured before attempting any course work.

"M" Management Courses
- M-581 Fire Program Management

"S" Suppression Skills Courses
- S-130 Firefighter Training (2008)
- S-230 Crew Boss (Single Resource, Blended) (2012)
- S-231 Engine Boss (Single Resource, Blended) (2012)

**Job aids** or "how to" books are designed to be used in lieu of formal classroom training. Job aids are used by trainees to gain knowledge prior to completing a position task book and also by individuals qualified in a position as an aid or refresher in performing the job. These publications can be downloaded on the NWCG Web site at <http://www.nwcg.gov/pms/resources/jobaids.htm>.
- J-158 Radio Operator
- J-236 Staging Area Manager
- J-252 Ordering Manager
- J-253 Receiving and Distribution Manager
- J-254 Base Camp Manager
- J-255 Equipment Manager (July 2004)
- J-257 Incident Communications Center Manager
- J-259 Security Manager (July 2004)
- J-342 Documentation Unit Leader (Nov 2008)

process to NWCG Training results in a performance-based system that places safety and successful performance as the highest priorities. Clark and Harrelson in their 2002 work, *Designing Instruction That Supports Cognitive Learning Processes,* deal extensively with the concept of dividing work into near- and far-transfer tasks. They provide the following definitions:

> "A near-transfer task is one that is performed more or less the same way each time by following a series of prescribed steps. These tasks are procedural.... In contrast, far-transfer tasks do not have one invariant approach. The practitioner must assess the environment and use judgment to adapt guidelines when performing far-transfer tasks.... The instructional methods to ensure the transfer differ between near- and far-transfer tasks; therefore, distinction between the 2 types of tasks is important" (Clark and Harrelson 2002, p. 154).

It is helpful to annotate whether a task lends itself to either foundational learning or an environmental job aid, which is a document or device that assists in the performance of one's duties. An example is a hydraulics calculator for computing pump pressure. Near-transfer tasks are prime candidates for job aid consideration. A portable water pump provides an example of the difference between when a task should be covered with WBT or ILT (foundational learning), or a job aid (environmental learning). The basic concept behind how portable water pumps work, how to operate them, and how to maintain them is foundational *near* learning. Because of the vast number of different portable water pumps in operation throughout the wildland firefighting community, environmental learning in the form of a job aid should be used to cover the specifics of operation and maintenance for one particular pump.

An example of foundational *far* learning is the effective deployment of a portable pump operation that could entail multiple pumps, over multiple elevation changes using hundreds of feet of water hose; deployment thus requires complex hydraulic knowledge. Multiple scenarios covering various levels of portable pump operation complexity would be used to help develop a safe, successful performer.

Annotating the learning by the type of learning (near and far) and either foundational or environmental will provide a great deal of information on how to design the lesson content. For instance:

- If it is environmental learning, then make a job aid.
- If it is foundational learning, then decide if it is near or far learning.
    - If it is foundational *near* learning, then proceed with the *tell–show–do* process.
    - If it is foundational *far* learning, then determine what experience will help achieve this far-learning task. Use goal-based scenarios to develop the learning process.

Use the job analysis data to prepare realistic case studies that will help develop the students' understanding of the task. Use case studies that mentally guide the student through possible scenarios.

A developing scenario can be very similar to a case study. The context of a developing scenario builds upon the original scenario in order to assist with the mastery of new learning material. Often we will build upon one scenario for an entire course in order to have a common incident for the entire class to relate to. Use a developing scenario while the lesson content is being delivered (Ionas et al. 2012). Build the developing scenario to establish context for the new lesson material. Then, present a similar scenario with differing environmental elements for the students to apply the new material. This is similar to the problem-based learning that Hong describes: "Problem-based learning is a curriculum approach that helps the students frame experiences through a series of problem-solving activities" (Hong 2002, p. 273).

At the end of this step, you should have a learning path that is broken into tasks. Each task would have various annotations such as near or far foundational learning, or environmental learning. You would then be ready to review the existing ILT course with the information you have created.

## Review of the Existing Course for Currency

Review the existing course for outdated information or for problem areas. This can be accomplished while other steps are being done. One useful tool is feedback based on the evaluations and critiques of the current ILT course, which will often provide insight into content that needs review. If you have subject matter experts help with the course revision, they can play a role in finding the sources for new information that may replace outdated content. As you note where the existing ILT course information falls along the learning path, you may notice that some areas lack content. This is where a gap analysis would be helpful.

## Gap Analysis

Examine your detailed learning path (with all the previous steps annotated) to help decide if there are tasks that need further content support. One key aspect is to identify current job performance requirements and ensure your learning path doesn't leave or create gaps that the course graduates will need to fill before entering the work environment. Interviews and workshops with subject matter experts can provide valuable information for creating the source of content to fill in the gaps. While this step can easily be glossed over, it is important to spend time considering how you will use the analysis to determine whether you need more information. With NWCG Training courses it is common that regulations or other governance may have changed since the original ILT course was authored. With this detailed learning path, you are now ready to transition to the design phase.

## Transition to the Design Phase

Ionas et al. provide good advice as you enter this phase: "Design and develop a learning experience to provide a contextualization layer to the course content" (Ionas et al. 2102, p. 14). This is further supported by McGee and Reis: "The focus of design is on what the instructor and the learner do rather than the delivery mode" (McGee and Reis 2012, p. 11).

While you may enter a course conversion process with the solid expectation of converting a course to WBT, keep what is best for the learner as the primary driver. You may find that a task needs to have two components—one that is delivered online and the other that by necessity is ILT. Safety items and tasks that need to be demonstrated and assessed by an evaluator are common multidimensional tasks.

## Summary

This brief process has developed over the past few years at NWCG Training. It is flexible and very efficient in the final form. By beginning with the audience and job as your baseline, you will have a solid idea of how to connect the two. Then use the information to create a learning path where you break out the tasks and classify them as RLO, environmental, foundational, or near and far learning, to see where the existing ILT content applies. Finally, the areas where content is missing or weak should stand out and you can source new information for those areas.

This process will not only allow you to convert an ILT course to either online or blended format, but also give you confidence that you have successfully kept it focused on the student and job to be safely and effectively performed.

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# Guidelines for Contributors

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