

# **Fiscal Year 2008 Large-Cost Fire Independent Review**

**A Report on Fiscal Year 2008 Large-Cost Fires  
by the Large-Cost Fire Independent Review Panel  
Chartered by the U.S. Secretary of Agriculture**

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**Dr. Mark Buckley**, Senior Economist, ECONorthwest, served as Panel Coordinator.

## ABSTRACT

This is the report of the fifth Large-Cost Fire Independent Review Panel. We considered 22 wildland fires that occurred in Fiscal Year (FY) 2008 with suppression costs exceeding \$10 million. Our primary determination was that the U.S. Forest Service (the agency) exercised prudent fiscal decisions with respect to public/firefighter safety, or the protection of natural resources and private property. Other issues that emerged from our review of FY 2008 fires included a need to strengthen the Forest Service safety culture, improve risk-informed management, develop a better understanding of major cost components including the use of the stratified cost index, develop and employ better strategic thinking, improve the effectiveness of review/oversight processes and provide a coordinated system of effective incentives.

## EXECUTIVE SUMMARY

This is the Fiscal Year (FY) 2008 report of the Large-Cost Fire Independent Review Panel chartered by the Secretary of Agriculture. We considered 22 wildland fires with suppression costs exceeding \$10 million: one in Wyoming (Forest Service Region 2), one in New Mexico (Region 3), 17 in California (Region 5) and three in Oregon (Region 6).

Our primary purpose is to determine whether or not the U.S. Forest Service (the agency) exercised fiscal diligence in managing specific incident suppression activities. We did not find any instance in which the agency did not execute prudent fiscal decisions with respect to public/firefighter safety, or the protection of natural resources and private property.

To reach this conclusion, we addressed three distinct but related questions:

### **A. Is there any evidence of fiscal malfeasance in agency large wildland fire management?**

We found no evidence of malfeasance.

### **B. Did the agency follow applicable guidelines in the preparation of regional large wildland fire cost reviews?**

Regions 2 and 5 closely followed guidelines from the Forest Service 2007 *Regional Large Fire Cost Review Guidebook*. Regions 3 and 6 followed the guidelines less precisely while indicating that the regional review process could be improved by accommodating innovative approaches – such as completing reviews during, rather than after an incident.

### **C. Did the agency take appropriate steps to manage the FY 2008 large fires in a cost-effective manner?**

We conclude that the Forest Service has implemented many measures to improve its cost-effectiveness and plans to implement more during the 2009 fire season. There are important, ripe opportunities to improve cost-effectiveness even more, however. We provide insight into seven of these opportunities, the first five of which we believe deserve specific responses.

#### **1. Develop and Employ Better Strategic Thinking**

For the most part, line officers and incident managers applied risk-informed, strategic thinking as they addressed the large fires of FY 2008. The agency as a whole, however, has not developed the strategic framework required to manage risks and improve cost-effectiveness across regions and over multi-year time periods. In many instances, the lack of adequate resources contributed to fire managers' inability to keep small fires from evolving into large fires. Fire managers lack guidance that would allow them to recognize sooner that a fire will burn for a long duration and adopt a strategy that entails lower daily costs. Aggressively seeking to suppress all fires overlooks the importance of fire in forest ecosystems and may set the stage for more intense, dangerous, and costly

fires in the future by preventing low-intensity fires from consuming fuel. Some line officers and incident managers feel they lack the training and institutional support to balance fire-suppression goals with socio-political, ecosystem-management, and other goals. We recommend that the Forest Service take appropriate action to establish a strategic framework on these issues. This action should (1) provide fire managers with coherent direction to improve risk management and cost effectiveness across regions and over multi-year periods; (2) evaluate the net benefits of providing additional resources to keep small fires from becoming expensive large fires; (3) develop guidance for recognizing sooner that a fire will burn for a long duration and adopting a management strategy with lower daily costs; and (4) improve fire managers' ability to balance fire-suppression, socio-political, ecosystem-management, and other goals.

## **2. Improve Risk-Informed Management**

The National Incident Management Organization (NIMO) teams recently developed protocols for the continuous improvement of risk-based decision-making for the management of large fires. We recommend that line officers and incident managers take appropriate steps to follow these protocols, and to expand the use of risk-oriented decision tools, such as Fire Spread Probability (FSPro) and Rapid Assessment of Values-at-Risk (RAVAR). As they do so, we urge them to be aware of the potential limitations and unintended consequences of these innovations. For example, using RAVAR to support decisions without compensating for its lack of information about the value of natural and cultural resources may lead to outcomes that disfavor the protection of these resources relative to structures. We especially caution against the potential tendency for some to see the tools as a substitute for, rather than inputs to sound decision-making.

## **3. Develop Better Understanding of Major Cost Components**

We encountered several limitations in the agency's ability to manage different components of the costs of suppressing large fires in a cost-efficient manner. Some of these arise from imperfections in the three major cost-accounting systems – I-Suite, Form 209, and Albuquerque Service Center financial codes – which do not provide fire managers with accurate, timely, comprehensive information. We recommend prompt action to correct this deficiency so that fire managers have accurate, timely information for estimating and tracking costs. Others arise from factors that influence the agency's costs directly. Of particular concern are socio-political pressures, which sometimes induce fire managers to use aviation resources when they have little, if any, impact on fire behavior; and the agency's failure to consider the non-financial costs of fire-suppression activities in a systematic and comprehensive manner. We recommend that the agency take appropriate action to address these concerns by increasing the ability of fire managers to account for the value of natural and cultural resources, and for socio-political pressures for actions that would reduce cost efficiency. We also recommend that the Forest Service increase its ability to measure the costs that might be avoided by renegotiating cost-sharing agreements with cooperating entities, especially in California.

#### **4. Act Promptly and Purposefully to Strengthen the Forest Service Safety Culture**

The Forest Service espouses these strategic objectives: make decisions that emphasize safety; conduct cost-effective fire fighting; and develop success-oriented alternatives. However, line officers and incident managers do not consistently apply these objectives when making tactical fire fighting decisions. To address this situation, managers at all levels of the agency should take prompt and persistent action to further and strengthen safety culture.

Toward this end, we recommend that the Forest Service develop a statement of principles that reflects agency core values. To complement this, we also recommend that the agency develop a set of behaviors that apply the principles. To reinforce the principles and behaviors, the agency should implement appropriate training and procedures consistent with the principles, encourage pervasive peer pressure supportive of the desired actions, and elicit comprehensive reporting (without any threat of retaliation) of infractions of procedures, training and principles. Each national forest or incident management team should accept responsibility for instituting the means to achieve a safety culture and auditing its own progress. We anticipate that safe operation will materialize as the sum total of behaviors that adhere to established safety principles.

#### **5. Provide a Coordinated System of Effective Incentives**

To reinforce future efforts to increase cost-effectiveness on large fires, we recommend the Forest Service:

- Provide predictable and consistent financial prizes to line officers and incident managers for exemplary cost-effective decisions.
- Negotiate cost-sharing agreements with cooperators that reduce their incentives to charge high rates, increase the use of resources, and increase federal costs.
- Allocate fire-suppression and -protection costs to the beneficiaries, to encourage them to engage in behaviors that reduce fire risk.
- Act quickly to correct the current incentives for protecting structures and non-federal property to the detriment of natural and cultural resources on federal lands.

#### **6. Improve the Stratified Cost Index**

The Stratified Cost Index (SCI) serves a critical role in Forest Service cost containment efforts. Although it has limitations because of the highly variable nature of wildland fires, it represents the best possible model in light of historically available data. As Forest Service efforts to incorporate spatially-explicit data into the model progress, significant improvements should result. Currently use of the SCI by fire personnel as a real time cost metric is limited: by unexplained and possibly possible large variation in the predicted value produced by the SCI; and (to a lesser extent) by inadequate user understanding of the SCI's purpose and limitations. We anticipate that both improvement in the



index, and further user training and practice should make the SCI a more effective tool in the future. To facilitate improvement in the SCI we recommend that the Forest Service incorporate into the SCI appropriate data so it better represents spatially explicit variation in fire-suppression costs.

### **7. Improve the Effectiveness of Review/Oversight Processes**

The agency's limited progress in implementing the recommendations from previous reviews suggests that the Forest Service should refresh its approach to implementing the recommendations and demonstrating its operational results. We recommend that the Forest Service consider the benefits of a more streamlined, rigorous, and targeted approach that coordinates internal and external reviews before, during, and after a fire season.

## **D. Emerging Issues**

We also identify five emerging issues that we anticipate will have significant impact on suppression cost of future large wildland fires:

1. The implications of co-incidental climate change, rural development, and other factors for fire management.
2. Changes in behavior stemming from the use of decision-support tools.
3. Managing a standing fire-fighting function within a land-management agency.
4. The significance of post-containment expenditures.
5. Guidelines for cost-sharing agreements.

We encourage Fire and Aviation Management to ask future Independent Panels to examine these emerging issues more closely.

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## I. INTRODUCTION

Since 2004 Congress has mandated an independent review for all large wildland fires with federal suppression expenditures exceeding \$10 million. Here, in the 5th Independent Large Wildland Fire Cost Review, we provide the findings of the Fiscal Year (FY) 2008 Large-Cost Fire Independent Review Panel. We did not find any instance in which the agency did not execute prudent fiscal decisions with respect to public/firefighter safety, or the protection of natural resources and private property. Based on our review of related information, we offer insight into areas of opportunity for the Forest Service to make efforts more cost-effective by improving risk and cost management.

### A. Overview of Fires in FY 2008

Large wildland fires in FY 2008 followed a number of existing trends, as did associated suppression activities and costs. The 22 large wildland fires with federal suppression costs exceeding \$10 million (Table 1)<sup>1</sup> were discontinuous and therefore difficult, meaning that they: crossed jurisdictional boundaries, threatened structures and property, and spread and merged across the landscape. Nearly half of the large wildfires were designated “complexes” to reflect their discontinuous and broad features. One fire was designated a “theater” fire, signifying a new threshold in landscape fire complexity.

The federal suppression costs for all 2008 fires as compiled by the National Interagency Fire Center are greater than the costs for 2007, even though total acres burned in 2008 are less than those burned in 2007 (Figure 1). Increasing overall federal fire-suppression costs continue the general long-term cost trend in place since the mid-1980s. The increasing long-term trend in total acres burned is weaker than the increasing cost trend. The 22 large wildland fires addressed in this review account for 20 percent of the acres burned but 38 percent of the total fire suppression expenditures. The single most-expensive wildland fire event ever occurred during 2008 was the Klamath Theater, with a federal cost exceeding \$124 million.

Suppression efforts required rapid and varied response, dependent upon fire-specific conditions for topography, fuels, weather, and valuable property. The developing decision tool kit, available to incident commanders and managers, provided a number of important benefits for tactical and strategic planning. However, professional experience and judgment continue to be seen as the most important factors for suppression effort success. As conditions change and fire behavior deviates from recent history, decision tools could see increased relevance. As events occur outside of the range of experience, tools can incorporate and anticipate emerging trends in fire behavior to complement the knowledge of experienced managers.

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<sup>1</sup> Additional representations of these data are shown in Figure A1 and as a map in Figure A2.

**Table 1. Summary of FY 2008 Wildfires with Federal Costs Exceeding \$10 million**

Fire Name	Region and Review <sup>a</sup>	National Forest	Federal Cost	Acres Burned	Structures Threatened (Destroyed)	Start Date	Number of Days
Klamath Theater <sup>b</sup>	5 Yes	Klamath; Six Rivers	\$124,449,135	192,038	312 (0)	6/20/08	98
Basin Complex	5 Yes	Los Padres	\$72,585,472	162,818	2,815-2,838 (58)	6/21/08	38
Iron-Alps Complex	5 Yes	Shasta-Trinity	\$70,423,201	105,805	1,177-1,550 (2)	6/21/08	75
Lime Complex	5 Yes	Shasta-Trinity	\$56,352,811	99,585	1,864-1,865 (5)	6/20/08	71
Canyon Complex	5 No	Plumas	\$45,890,222	47,680	2365 (3)	6/21/08	102
Indians	5 Yes	Los Padres	\$43,458,769	76,554	1,335 (15)	6/8/08	34
Slide	5 Yes	San Bernardino	\$26,219,776	12,759	10,000 (272)	10/22/07	40
Chalk	5 No	Los Padres	\$24,365,307	16,269	49 (0)	9/27/08	33
American River Complex	5 Yes	Tahoe	\$22,498,946	20,541	43 (2)	6/21/08	32
Cub Complex	5 Yes	Lassen	\$20,660,113	19,718	183 (0)	6/22/08	30
Piute	5 Yes	Sequoia	\$19,567,849	37,026	1,432 (5)	6/29/08	26
Rattle	6 Yes	Umpqua	\$18,570,723	19,775	34 (0)	8/17/08	59
Gap	5 No	Los Padres	\$17,042,013	9,443	3,239 (4)	7/01/08	27
Soda Complex (Big, Black, Monkey Rock, Mill)	5 Yes	Mendocino	\$15,636,928	8,632	7 (4)	6/21/08	37
Lonesome Complex	6 Yes	Siskiyou	\$15,517,375	21,125	3 (0)	8/16/08	55
Hell's Half Complex	5 No	Six Rivers	\$15,341,400	15,146	109 (1)	6/20/08	38
Yolla Bolly Complex	5 No	Mendocino	\$15,127,488	89,994	16 (0)	6/21/08	86
Gnarl Ridge	6 Yes	Mt Hood	\$12,784,975	3,280	43 (0)	8/08/08	91
Trigo	3 Yes	Cibola (NF & Grasslands)	\$12,756,144	13,709	158 (89)	4/15/08	29
Rich	5 Yes	Plumas	\$11,798,864	6,112	200 (9)	7/29/08	19
Santiago	5 No	Cleveland	\$10,522,845	28,400	3,150 (24)	10/21/07	18
Gunbarrel	2 Yes	Shoshone	\$11,200,000	68,149	36-58 (0)	7/26/08	81

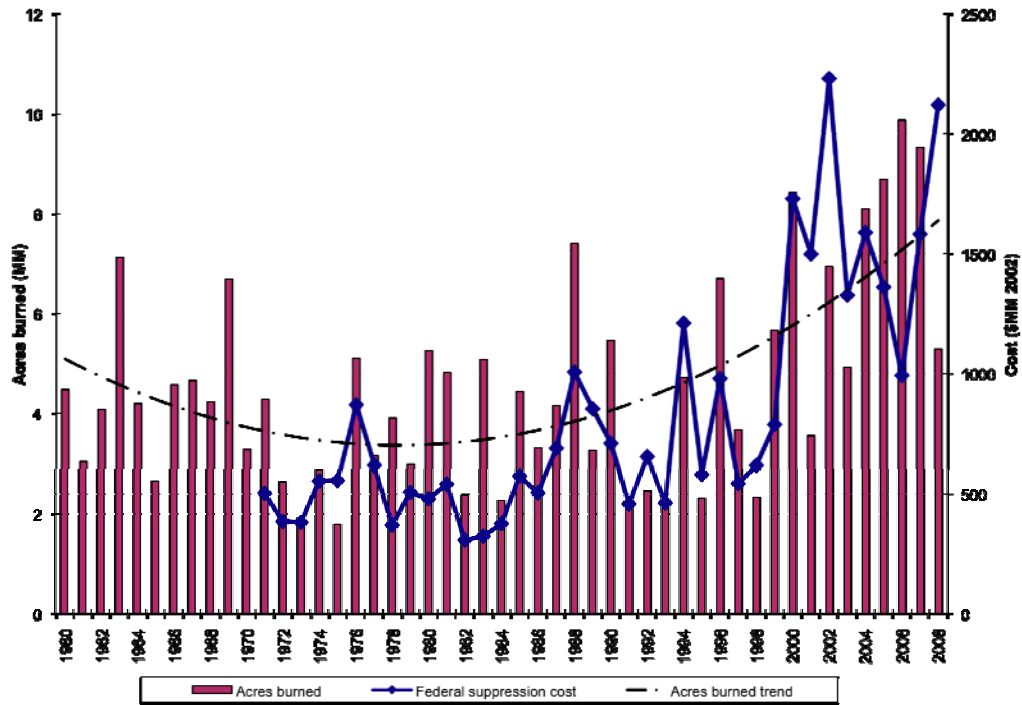
Source: ECONorthwest, with data from ICS-209 Database, InciWeb Incident Information System

Notes: <sup>a</sup> US Forest Service Region and indication of whether included in Regional Review.

<sup>b</sup> The original list of 26 incidents is reduced to 22 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater.

Complexes, the majority of which occurred simultaneously in northern California, dominated large wildland fires in FY 2008. These fires resulted from a combination of fuels, drought, and a lightning storm that generated thousands of lightning strikes in the region. The majority of costs for FY 2008 large wildfires originated from the lightning storm on June 20<sup>th</sup> through mid-August (Figure 2). Costs for these fires followed the general increasing trend, although the total acreage involved declined from the 2007 total acreage involved (Figure 1).

**Figure 1. Total Annual Wildfires Acres Burned and Federal Suppression Costs, 1960–2008<sup>a</sup>**

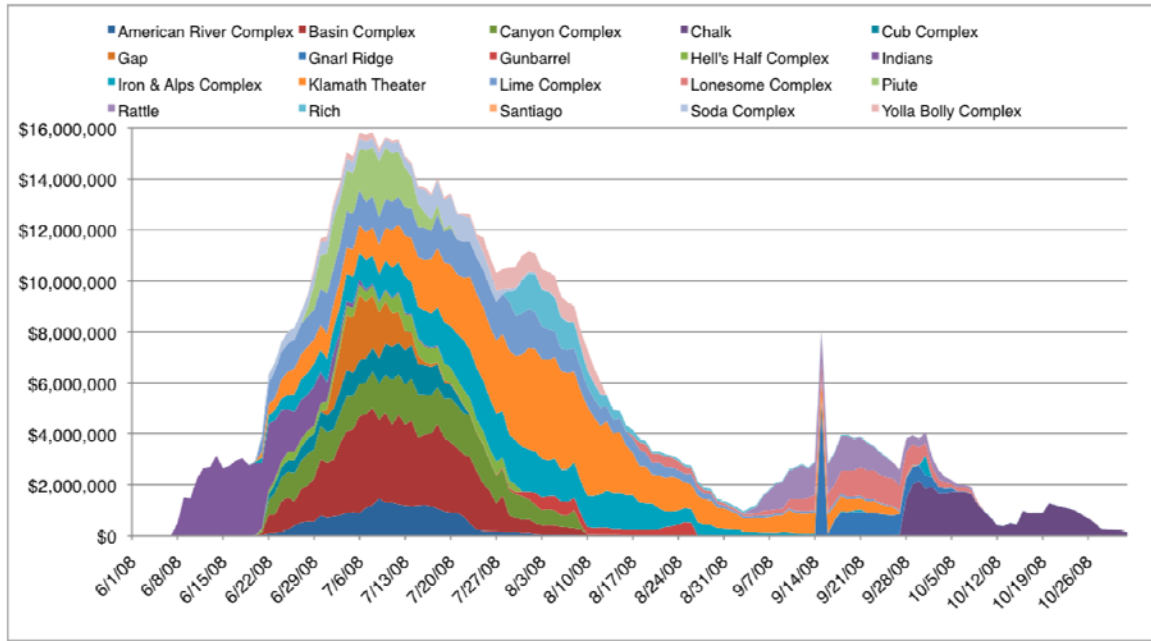


Source: ECONorthwest, with data from Holmes et al. (2007), U.S. Department of the Interior, Office of Budget (No Date), U.S. Department of Agriculture, Forest Service (2009), and U.S. Department of Labor, Bureau of Labor Statistics (No Date), and National Interagency Fire Center (No Date).

Note: <sup>a</sup>This figure was originally published by Holmes et al. (2007). The 2003–2008 suppression cost data were calculated by combining the respective suppression cost budget data from both the Department of the Interior and the Forest Service and converting to 2002\$ using the Producer Price Index (PPI). The 2003–2008 acres burned data were updated using the National Interagency Fire Center data on total fires and total acres burned.

The simultaneity and regional concentration of the northern California wildfires created unprecedented challenges for resource availability and suppression strategy. The move to “complex” and “theater” areas of command, contributed to efficient and coordinated resource allocation and suppression efforts. Insofar as the natural and social conditions that contributed to the high costs for the large wildfires in FY 2008 are part of an ongoing trend, lessons learned from the complex fires of FY 2008 will be important for future strategy, training, tool development, and resource allocation.

**Figure 2. Timing of Suppression Costs for the FY 2008 Large Fires (\$)**



Source: ECONorthwest, with data from the I-Suite Database.

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Willow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and Trigo and Slide are not shown because of data problems.

### Cost and Size Trends for Large Wildland Fires

Large wildland fires with federal suppression expenditures exceeding \$10 million numbered 22 for 2008. Seventeen of these were in California. Of the other fires exceeding \$10 million, three were in Oregon, one in New Mexico and one in Wyoming. Of the fires in California, 10 started June 20<sup>th</sup>-22<sup>nd</sup>, resulting from a series of lightning strikes in northern California. Many of these fires were complexes and several complexes eventually became the Klamath Theater of numerous individual fires that joined and/or were managed in combination. The total federal cost for these 22 fires was \$683 million, exceeding the \$548 million spent in 2007 on fires exceeding \$10 million. This is the largest total cost for large wildland fires since this series of reviews began in 2004. All 22 of the 2008 fires were managed by the U.S. Forest Service.

Federal suppression expenditures for the largest wildland fires are increasing. The single most expensive fire in 2006 involved \$74 million in federal expenditures, and was followed by \$103 million for the most expensive fire in 2007. The Klamath Theater fire of 2008 had federal expenditures of over \$124 million. The most expensive fires are not, in geographical terms, the largest ones. The largest FY 2008 fire, in terms of acres, the Glass Fire in Texas, had suppression costs of less than \$10 million.

Recent trends in fire suppression costs and acreage are not consistent between the set of large wildland fires (over \$10 million in federal suppression costs) and the set of all wildland fires. Overall, FY 2008 wildland fires were less numerous and burned fewer acres than 2007 and 2006 wildland fires. The 78,949 wildfires reported to the National Interagency Fire Center in 2008 burned 5.3 million acres. This is compared to 85,705 reported fires in 2007 that burned 9.3 million acres and the 96,385 reported fires in 2006 that burned 9.9 million acres.<sup>2</sup> Even though the short-term trend in number of fires and total burned acres shows a decline, the federal suppression cost trend for the fires exceeding \$10 million shows an increase.

## B. Overview of Scope of Work for the 5<sup>th</sup> Review

The scope of our review is “to determine if the Agency exercised fiscal diligence in managing specific incident suppression activities.” We considered the 22 wildfires, listed in Table 1 that passed the \$10 million threshold in FY 2008. We looked not only at how money was spent on these fires, but also at the following eight priority topics, identified by Fire and Aviation Management, regarding cost and risk associated with wildfire suppression:

1. Implementation of risk-informed management
2. Existing and potential incentives
3. Review processes and follow up
4. Comparison of suppression strategies
5. Resource allocation models and criteria utilized
6. Aviation resource cost management
7. Use of decision support technology, including the Stratified Cost Index, to support strategic incident management decisions
8. Linkage of objectives and Long-Term Implementation Plans

To complete our task, we reviewed data from different systems that compile data regarding the costs of individual fires, and conducted a meta analysis of the cost reviews completed earlier by the four Forest Service regions – 2, 4, 5, and 6 – that had large fires in FY 2008. We also interviewed Forest Service personnel – from forests, incident management teams, the Northern California Geographic Area Command Center, and the regional offices for Regions 3, 5 and 6 – who had significant managerial responsibility regarding fire costs.

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<sup>2</sup> National Interagency Fire Center. 2009. Wildland Fire Summary and Statistics 2008. Retrieved June 17, 2009 [http://www.predictiveservices.nifc.gov/intelligence/2008\\_statsumm/2008Stats&Summ.html](http://www.predictiveservices.nifc.gov/intelligence/2008_statsumm/2008Stats&Summ.html)



## II. PANEL REVIEW OF FISCAL DILIGENCE

Our primary purpose is to determine whether or not the Forest Service exercised fiscal diligence in managing specific incident suppression activities during FY 2008. We did not find any instance in which the agency did not execute prudent fiscal decisions with respect to public/firefighter safety, or the protection of natural resources and private property.<sup>3</sup> To reach this conclusion, we addressed three distinct but related questions:

1. Is there any evidence of fiscal malfeasance in agency large wildland fire management?
2. Did the agency follow applicable guidelines in the preparation of regional large wildland fire cost reviews?
3. Did the agency take appropriate steps to manage the FY 2008 large wildland fires in a cost-effective manner?

Table 2 summarizes our findings for these questions.

**Table 2. Summary of Findings**

Region	Evidence of Malfeasance	Compliance with Regional-Review Guidelines	Evidence of Cost-Effectiveness
Rocky Mountains (R-2)	None	Medium	Mixed
Southwest (R-3)	None	High	Mixed
Pacific Southwest (R-5)	None	High	Mixed
Pacific Northwest (R-6)	None	Low	Mixed

Source: Large-Cost Fire Independent Review Panel

### A. We Found No Evidence of Fiscal Malfeasance

We found no evidence of fiscal malfeasance in agency management of large wildland fires in FY 2008 (see Attachment 2 for a summary of our review). This conclusion rests on (1) our meta analysis of Forest Service reviews of large-cost fires for each of the four regions that experienced at least one fire with suppression costs greater than \$10 million, and (2) our examination of relevant data and interviews of personnel from each of the four regions. None of the regional reviews reports evidence of malfeasance, and we uncovered no evidence through our examination of the data and interviews.

Confidence in our conclusion is bolstered by our observation that the agency managed the large fires of FY 2008 with an institutional system that incorporates multiple fiscal checks and balances. The system is solid, but not perfect. Its

<sup>3</sup> U.S. Department of Agriculture, Forest Service, Fire and Aviation Management. 2009. *Description/Specification/Statement of Work*.



implementation varies across fires and incident management teams, and its information-management components are cumbersome, uncoordinated, and inefficient (see the text box on page 15). These shortcomings do not appear to undermine the overall integrity of the system or the prudence of fire-suppression decisions, but we recommend that the agency take appropriate steps to make the system more robust. We describe some of these steps in Section III.

## **B. The Regional Cost Reviews Are Inconsistent**

Because our findings rely extensively on our meta analysis of regional reviews, we report our evaluation of agency compliance with applicable guidelines for the preparation of these reviews. The basis for our evaluation is the Forest Service May 2007 *Regional Large Fire Cost Review Guidebook*, which reflects “Generally Accepted Government Auditing Standards” (GAGAS) for performance audits. Each review was completed after the fire season.

Compliance with the *Guidebook* is uneven. This outcome arises, in part, from frustration at the regional level with the review process and uncertainty about its efficacy. The review by Region 6 exhibits the lowest level of compliance, for example, but staff from the region explained that they concentrated more on reviewing the strategies and tactics of incident management teams during a fire and find that this approach yields better outcomes. Personnel from the other regions indicated that this approach might yield better outcomes from their areas as well. Accordingly, we recommend that the agency clarify its objectives, requirements, and methodology for the regional reviews. Attachments 3 and 5 provide more detail regarding our investigation, findings, and recommendations.

## **C. The Agency Has Implemented Many Measures to Improve Cost-effectiveness and Risk Management; There Are Ripe Opportunities to Do More**

In its charge to the Panel, Fire and Aviation Management set objectives targeting risk-informed management, and asked us to focus, as possible, on these areas:

- Agency implementation of risk-informed management
- Specific impacts of selected suppression strategies vs. alternative strategies
- Resource allocation models and criteria utilized
- Demonstrated progress in aviation resource cost management
- Effective use of decision support technology, including the Stratified Cost Index, to support strategic incident management decisions
- Effective and coherent objectives linked to Long-Term Implementation Plans

Our investigation of these six areas finds that senior line officers and members of incident management teams associated with the FY 2008 large wildland fires fully recognize the importance of managing risk and controlling suppression costs, and took many steps – strategic and tactical, large and small – to accomplish those objectives. As our investigation of the six areas evolved, it produced the insights into ripe opportunities for further improving risk-informed management and cost-effectiveness. We discuss these in the next section. Our investigation also revealed some emerging issues that will influence costs in the future. We discuss these in Section IV.

### **III. INSIGHTS FROM THE REVIEW**

In this section we present our findings regarding the priority topics set for us by Fire and Aviation Management regarding its objectives for risk-informed management. Based on our investigation, and to facilitate our presentation, we separate our discussion into seven broad topics. Within each topic, we make recommendations for future actions that we believe will lead to greater cost-effectiveness. We believe the first five topics and associated recommendations have sufficiently high priority to warrant specific responses.

#### **A. Develop and Employ Better Strategic Thinking**

Line officers and incident managers are repeatedly encouraged to apply risk-informed, strategic thinking as they address large fires, and our investigation indicates that, for the most part, they responded appropriately to these directives as they attacked individual large fires and fire complexes in FY 2008. We did not, however, find that the agency as a whole has fully developed the larger, strategic framework required to manage risks and improve cost-effectiveness across regions and over multi-year time periods. Without this framework, fire suppression efforts on larger fires sometimes lacked the strategic coherence necessary to be truly effective (as described in the remainder of this section). We recommend that the Forest Service initiate efforts to define, develop, and implement this broader strategic framework, thereby providing fire managers with coherent direction to improve risk management and cost effectiveness across regions and over multi-year periods.

The lack of coherence in strategic thinking at different spatial and temporal scales seems to stem largely from uncertainty about the agency's complex and often contradictory goals and from an institutional structure that, although rapidly changing, is sometimes out of step with the fire-related demands it should address. As a consequence, while the agency is working hard to improve its capability to implement risk-informed management of individual fires, senior line officers and incident managers seem to lack clear guidance for measuring the potential impacts and weighing the risks associated with alternative fire-suppression strategies. The following examples illustrate the situation.

## **An Emphasis on Initial Attack without Sufficient Resources to Be Successful**

The core of the Forest Service overall fire-suppression strategy has long concentrated on identifying, attacking, and suppressing fires when they are small, keeping them from becoming large, dangerous, and costly. In some situations, however, it fails to adequately prepare and provide sufficient resources to enable full implementation of this strategy. This was the case in northern California when, over a 33-hour period in June a storm produced 5,146 lightning strikes that ignited 1,010 fires, 643 on federal lands (Holt et al. 2009). Lightning also ignited fires elsewhere in California and, by June 28, the state had 1,217 uncontained fires, overwhelming the fire-suppression processes and procedures of the Forest Service and others. Nonetheless, the Forest Service responded admirably. Of the 136 ignitions on the Shasta-Trinity National Forest, for example, it contained 119 at less than 99 acres and nine at less than 5,000 acres. But eight became large fires, whose containment had a total cost of about \$27 million. A similar pattern materialized throughout the region, and northern California accounted for about half of the national total of large fires on federal lands with suppression costs exceeding \$10 million.

Senior fire staff officers expressed to us their belief that, with additional resources, they could have prevented some, perhaps all, of the large fires. Some have explained the lack of sufficient resources by suggesting that the event was unprecedented and so extreme that the agency could not have anticipated and prepared for it. The historical record indicates otherwise. This event was a sharp deviation from normal experience, especially insofar as the lightning ignitions occurred so early in the year, but similar events had occurred in 1955, 1987, and 1999. These earlier events show that the region faces substantial risks associated with low-probability, high-consequence fire events across Region 5. Similar circumstances are not uncommon across the western regions: our examination of the regional reviews and interviews with line officers and incident managers found that scarcity of crews, engines, aircraft, and other resources often was cited as a major contributing factor that enabled small fires to become large fires.

Preparing for and managing such risks, requires a risk-management framework commensurate in scale and scope. It also requires an assessment of the cost-effectiveness of increased levels of preparedness. If the agency is to maintain its initial-attack strategy, we recommend that it evaluate the net benefits of providing additional resources to keep small fires from becoming expensive large fires. It should: continually assess the risk of low-probability, high-consequence events; weigh the risks and costs of providing enough initial-attack resources to be ready for such an event against those of not doing so; seek the appropriate level of resources; and communicate the reasons for and the consequences of its decisions. This effort should reveal if the money saved by preventing a large fire might pay for a considerable increase in initial-attack resources and still yield net savings for tax payers. It also should involve scenario planning that considers large areas, multiple years, and potential interactions among multiple units within the Forest Service as well as other entities.

## Limited Understanding of the Patterns in Which Suppression Costs Evolve

Figure A3 shows that, for many fires, suppression costs exhibit a common pattern: the daily cost increases for a period and then diminishes.<sup>4</sup> The point where the daily cost begins to diminish—known as the cost inflection point—often occurs about at the same time fire managers have determined that the fire will be a long-duration fire. At which point they alter their strategy, from aggressively seeking to suppress it, to a more measured strategy. From our review of the cost data and discussions with fire managers, we conclude that for some of the FY 2008 fires, costs probably would have been lower, without substantially altering the fires' overall effects of values at risk, by acting sooner to declare them long-duration fires. Accordingly, we recommend that the Forest Service develop guidance for recognizing sooner that a fire will burn for a long duration and adopting a management strategy with lower daily costs by using Type 3 or 4 management teams. This may require increased capability for Type 3 and 4 teams. The effects of duration for the 22 fires we reviewed are shown in Table A2. We recommend that further investigation be undertaken to assess the potential for such actions to lower suppression costs in the future.

## Emphasis on Fire Suppression Conflicts with Ecosystem Realities

Line officers and incident managers have reported that they generally perceive their task is to develop and implement fire suppression strategies aimed at minimizing fire activity, subject to concerns about the safety and cost-effectiveness of specific incident management activities. Fire is an essential element of forest ecosystems, however, especially those where the large fires of FY 2008 occurred. Hence, aggressively suppressing all fires may interfere with or distort natural ecosystem processes. Moreover, suppressing all fires now may set the stage for more intense, dangerous, and costly fires in the future by preventing low-intensity fires from consuming fuels and allowing the supply of fuel available for future fires to increase. Preventing low-intensity fires from consuming fuel may become an even more important contributing factor for future large fires as anticipated changes in climate increase the aridity of some western forests.

Our investigation indicates that the agency has not provided line officers and incident managers in the four regions where large fires occurred in FY 2008 with a suitable strategic framework for addressing the conflict between the emphasis on fire suppression and ecosystem realities. As a consequence, they did not express to us a coherent approach for assessing the specific impacts of selected suppression strategies vs. alternative strategies, or for defining appropriate criteria for evaluating resource-allocation options. Especially when suppression resources were limited, some fire managers took actions that recognized the

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<sup>4</sup> Table A1 shows the same pattern using weekly data.

potential for low-intensity fires to generate ecological benefits and reduce the dangers and costs of future fires in the same area, but they apparently did so without clear strategic guidance.

We recommend that the agency, as soon as possible, initiate efforts to develop a clear framework for making strategic decisions regarding the potential conflict between fire suppression and ecosystem realities. These efforts should describe the short-and long-run implications for the risks and costs associated with its current emphasis on fire suppression, consider alternatives, and evaluate their relative plusses and minuses.

### **Incomplete Preparation for Balancing or Choosing among Multiple Goals**

Line officers and incident managers on the large fires of FY 2008 often had to choose between competing goals without an adequate strategic framework for doing so. Development of such a framework likely would improve agency overall ability to manage risks and reduce costs in a coherent, consistent manner. The framework should address multiple goals involving potential mutual gains and tradeoffs between safety and costs, socio-political pressures, incentives for Forest Service personnel working on large fires, and managing fires to protect values at risk.

Sometimes, although they saw their primary goal was to contain a large fire in a safe and cost-effective manner, line officers and incident managers perceived safety and cost-reduction to be competing goals, between which they had to choose. In at least some of these situations, it appears they likely would have avoided this tradeoff if the agency as a whole had in place a long-run effort emphasizing the mutuality between safety and cost-reduction. We discuss this mutuality in detail in Attachment 4.

The line officers and incident managers on the large fires of FY 2008 discussed with us their recognition that, although their primary goal was to suppress the fire in a safe, cost-effective manner, they often had to contend with socio-political pressures with contradictory goals. Feeling that they must address these goals, they sometimes made decisions to commit resources, expose personnel to risks, and incur costs with little or no meaningful effect on the fire. For example, the Region 5 review reports that, in response for demands to increase the visibility of fire-suppression efforts, some air drops of retardant were made so they could be filmed and shown on television, even though conditions were such that little, if any, of the material reached the ground. The line officers and incident managers addressed such demands without a clear strategic framework for doing so, and considerable uncertainty about the extent to which they would receive support for their decisions.

Forest Service personnel working on fires do so with little incentive other than the satisfaction that comes from their enthusiasm and commitment to the task. They are drawn away from the duties associated with regular jobs. They must

scramble to complete tasks left undone while they were away on a fire. And their performance review typically focuses solely on their completion of tasks unrelated to their fire-related activities. Some line officers and incident managers expressed to us their concern that this arrangement can interfere with morale and decision-making, especially as fires consume an ever-greater portion of agency budget. The concern can be even greater when a Forest Service employee works on a fire alongside, and doing the same tasks as, contract personnel being paid substantially higher rates. Local and regional fire managers have little, if any, control over these factors; if they are to be addressed, action must occur at the senior management level of the agency.

Our investigation indicates that, as line officers and incident managers worked to contain the large fires of FY 2008 with limited resources, they sometimes had to protect people, property, and resources with a higher value and sacrifice those with a lower value. They did so, however, with information and decision-support tools that are incomplete so that, sometimes the things that were protected may have a lower value than those that were not protected. They especially expressed concern that such outcomes occurred because they lacked information about the value of the natural resources, such as wildlife habitat or watersheds, on Forest Service lands, and, hence, these resources received too little protection. They also expressed concern that socio-political pressures sometimes precluded cost efficient actions. On some fires, this is a significant driver of cost. It is debatable whether the agency handles this type of influence very well. In principle, the agency is not supposed to bow to these kinds of political pressures. In practice, it does happen with a rate and effect that is currently undocumented, though frequently discussed.

In response to these concerns, we recommend that the Forest Service take

### **Using Decision Tools to Support Sound Strategic Thinking that Resulted in Significant Cost Savings**

On June 30<sup>th</sup>, 2008, the No-Man's fire began on the Klamath National Forest near the Siskiyou Complex. Local knowledge and experience from the District and Forest levels suggested that this fire had a high probability of rapidly becoming a large fire, similar in size and behavior to the Siskiyou Complex.

The Line Officer requested an emergency FS-Pro computer model run from the local fire behavior specialist. The results helped to confirm the decision bring the fire to the high and immediate priority for the Forest.

No additional resources were available from the GACC, and the Forest FMO worked with the District Ranger and FMO to plan resource needs. The Siskiyou Complex fire had resources that could be diverted with minimal risk to changes in fire behavior for a short time period. The decision was made to work internally and collaboratively to volunteer resources from the Siskiyou to divert to the No Mans fire to meet the objective of suppressing the fire while there was opportunity.

The fire was contained at 120 acres in six days and the resources were returned to the Siskiyou Complex. The estimated cost of this effort was \$100,000.<sup>1</sup>

Had the crews not deployed, the average 7-day prediction of 1,000 fire simulations for the No-Man's fire suggests the fire size would have grown to approximately 4,100 acres, costing an estimated \$3.3 million.

<sup>1</sup> Based on average cost per day on Klamath Theater I-Suites estimates.



appropriate action to improve fire managers' ability to balance fire-suppression, socio-political, ecosystem-management, and other goals. In some situations, the balancing of these goals should recognize that the development of homes adjacent to Forest Service lands means that the resources on these lands will inevitably be sacrificed, regardless of their value, if a fire should threaten the structures. More widespread use of Rapid Assessment of Values-at-Risk (RAVAR), which highlights the value of structures and infrastructure but excludes natural-resource values, may make these outcomes more likely. Until this gap in information about resource values is filled, fire managers would benefit from having a strategic framework that provides better guidance.

## **B. Improve the Use of Risk-Informed Management**

We find that agency administrators, their staff, and incident managers are making significant, explicit progress in improving decision-making for all fires that escape initial attack. The activities of the National Incident Management Organization (NIMO) teams, initiated in 2006, have played an instrumental role. For example, they have developed the application of a risk-informed approach to decision-making on large fires, and they applied this approach on some of the larger fires in FY 2008. The NIMO teams recently developed protocols for the continuous improvement of risk-based decision-making for the management of large fires.<sup>5</sup> We recommend that the Forest Service implement these protocols.

The protocols focus on the large and costly fires with the intent to improve risk management and, consequently, lower risks to fire fighters and the public. They have pre-season, incident, and post-season components that emphasize the continuous nature of managing risks. Especially heartening to us is the focus in the pre-season on training line officers on high-risk forests (colloquially "the dirty thirty") to expand their capacity to effectively manage large fires. This training includes using decision-support tools, understanding the Incident Risk Assessment framework, developing collaborative relations among line officers and incident managers, expanding capability to make risk-informed decisions, and communicating risks and the management of risks to non-federal and public stakeholders.

These changes, though commendable, have not been fully tested – raising uncertainty about how all of this will function as the 2009 fire season evolves. Accordingly, we recommend that line officers and incident managers continually recognize that decision-support tools can provide inputs to, but should not substitute for sound decision making. We encountered uncertainty about the availability of long term analysts (LTANs) to support multiple fires and about the switch from Wildland Fire Situation Analysis (WFSA) to Wildland Fire Decision Support System (WFDSS) to document decisions. In many ways, these

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<sup>5</sup> *National Incident Management Protocol for National Incident Management Organizations (NIMO): A Risk-Based Fire Management Protocol for Very High and Extreme Risk Wildland Fires.* Version 4.0. June 2009.

are common concerns that accompany the introduction of any new techniques and procedures and will need to be managed in that context. Several fire managers observed that, because RAVAR incorporates only data about structures and infrastructure to describe resources at risk, it tends to encourage strategies aimed at protecting those things, often located near the edge of a forest, to the detriment of natural and cultural resources.

More troublesome is uncertainty about how these new techniques and procedures will intersect with fire managers' understanding of the risks associated with large fires. Our concern is illustrated by our interviews of fire managers in northern California (where about half of the nation's FY 2008 large fires were ignited over a short period by lightning). Many interviewees viewed the event as unique and, hence, concluded that the fire-management system could not have anticipated and prepared for it. The historical record, however, shows this was the third such event on these forests since 1987.<sup>6</sup> Three multiple ignition events in 22 years suggests the probability of such an event is about 14 percent each year, high enough that prudent planning would anticipate and prepare for it each year. Moreover, fire managers reported that many residents and political leaders of nearby communities were surprised by the widespread fires and applied pressure to eliminate them and the blanket of smoke that covered the area. This illustration reinforces a point similar to the one we make in our discussion of a

## Data Inaccuracies and Inconsistencies: I-Suite, Form 209, ASC Financial Codes

There is no central system for managing resource costs. We investigated the three major datasets that managers use to make cost-related decisions in fire management. Overall these systems are not designed to accurately track cost information at the scale that reflects fire management decisions, especially for fires that complex or where resources are limited.

**Key Finding:** *Financial datasets used to track individual fires are inaccurate and inconsistent. This limits their utility for use in fire cost tracking at the Forest, Regional and National Levels.*

The following describes the utility and limitations of each system and dataset.

**ASC Database (P-Codes):** The LFCR was keyed to 26 individual financial "P" Codes from the ASC costing in excess of \$10 million. The inaccurate assumption is that an individual P-Code is a discrete fire event. In reality many of these fire events involved multiple incidents and multiple P-Codes. To assess total cost, it is necessary to link all incidents with all P-Codes for a given fire event. We found no reliable method to ensure all financial data were pooled to calculate actual cost of a given fire event. The ASC financial data appear to be the most accurate assessment of total fire cost if all relevant financial P-Codes are included.

**I-Suite Database:** Cost data for each incident are stored in individual I-Suite databases and are not directly linked with one another. I-Suite was not designed to accommodate fire complexes (aggregation of multiple incidents) nor to provide accurate cost-level information for personnel resources. When a fire event changes status or is aggregated or disaggregated into others, the I-Suite dataset is abandoned or later reinstated to track costs by the active incident number. To assess total fire cost per day, it is necessary to pool all incidents for a given fire; the accuracy and utility is highly dependent upon the individual operator of the database and ability to access the source data in the field (ROSS database). There is no clear and consistent inventory of incidents that correspond with activities on the ground.

**Form 209:** The financial data provided on the Form 209 are generated from the I-Suite database on a given day. The values from the 209 could not be accurately replicated from the I-Suite database for a given incident. It is not clear which cost values are included or excluded. There is no current method to link the 209 information with ASC financial data (P-Codes).

<sup>6</sup> Wildland Fire Lessons Learned Center, Information Collection Team. 2009. *Initial Impressions from the Northern California 2008 Lightning Siege*. June. Retrieved June 18, 2009, from [http://www.wildfirelessons.net/documents/Initial\\_Impressions\\_NorCal\\_2008\\_Lightning\\_Siege.pdf](http://www.wildfirelessons.net/documents/Initial_Impressions_NorCal_2008_Lightning_Siege.pdf)



safety culture: risk-informed management is the sum total of behaviors that adhere to better assessing risks, communicating those risks within the Forest Service and to the public, consistently applying decision tools and techniques, and selecting efficient and effective management methods.

## **C. Develop a Better Understanding of Major Cost Components**

The system, called I-Suite, most commonly used by fire managers to monitor costs on large fires in FY 2008 reports costs for five categories of activities: camp support, personnel, equipment, crews, aircraft, and supplies. Figures A4 and A5 and Tables A3 and A4 show the distribution of costs by category, expressed as a total and percentage, for each of the 22 fires we reviewed.<sup>7</sup> In general, there was little variation among the components, although a few fires had distinctive characteristics: the Gap Fire had high equipment costs, for example, and the Gunbarrel Fire had high aviation costs. This pattern is similar to those of previous years.

We encountered several limitations in Forest Service ability to manage different components of the costs of suppressing large fires in a cost-efficient manner. Some of these arise from imperfections in its multiple cost-accounting systems, no one of which provides fire managers with accurate, timely, comprehensive information. Other limitations occur from the complexity of the forces that influence some costs, especially those associated with aviation and with California.

In our interviews with fire managers we encountered a fading opinion that costs are necessarily an output from fire-suppression decisions rather than an appropriate input for making the decisions. The changing perspective seems to arise from directives, reviews, training, increased interactions between agency administrators and incident management teams about cost containment. In some cases, notably in Region 6, agency administrators reinforced these factors by providing explicit budget constraints to incident management teams.

### **Cost-Estimation and Accounting Systems**

Agency systems for estimating and measuring the costs of large wildland fires can diminish the ability of fire managers to make cost-efficient decisions. Several line officers and incident managers observed that they want two types of reliable cost estimates. One type would estimate the overall cost of achieving fire-suppression objectives specified by the Agency Administrator, the other type would estimate costs for different fire management tactics that might evolve over multiple days. Some felt that WFSA provided a tool for developing the first type

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<sup>7</sup> Figure A3 shows the distribution of costs by category by day for each of the 22 fires we reviewed.

of estimate, and expressed concern that this capability would be lost with the adoption of WFDSS. There appears to be no reliable tool for developing cost estimates for what-if scenarios that consider alternative tactics over multiple days.

The Forest Service has three separate systems for measuring costs. None provides a comprehensive, accurate compilation of total fire costs, or has the capability to give fire managers the accurate, timely information they require to monitor costs as they assess the consequences of their strategic and tactical decisions. The text box on page 14 and Table A5 provide more detail. We recommend that the Forest Service take appropriate action to rectify the deficiencies in these systems so they provide fire managers with accurate, timely information for estimating and tracking costs.

### **Aviation Costs**

Aviation accounted for 14 percent of large wildland fire costs on the fires we reviewed, but it ranged from 3 to 27 percent per fire. This variation reflects the different roles aviation resources can play in fire suppression. On fires spread over a large area, aviation sometimes offered the only means for moving crews quickly. On the Los Padres National Forest, aviation resources were crucial for initial attack to slow the progress of a fire spreading quickly through inaccessible terrain. In the Shoshone National Forest, aviation resources were used for point protection. Line officers and incident managers frequently said that the use of aviation to drop water and retardant, in conjunction with the activities of ground crew, were typically required for full containment. Line officers and incident managers generally acknowledge that aviation resources are expensive, and they express a desire to control their use. On the other hand they also acknowledge that they sometimes are tempted to use aviation resources beyond cost-efficient levels.

Aviation costs often arise from the sociopolitical context surrounding a fire, where major stakeholders see the use of aviation resources as a highly desired and visible symbol of agency efforts to suppress a fire, reduce smoke, and protect values at risk. When communities feel threatened by nearby fires, particularly with visible smoke, the public can demand that all available resources, particularly aviation resources, be brought to bear. Incident managers and line officers can feel the pressure arising from this demand – directly from local residents or via elected officials. In some instances, it appears they responded by calling for the use of aviation resources, knowing that this would have little or no effect on the fire itself. We also found cases where, through extended efforts to explain how and when aviation resources can make a meaningful difference in a fire's behavior, Forest Service staff have blunted socio-political pressure for the symbolic use of these resources. In general, the fire managers we interviewed expressed a desire to receive not just guidance but also training in how to respond to such pressures. Some suggested that, if stakeholders became more aware of the costs of aviation resources, and if they faced the prospect of having

to shoulder a large share of these costs, the public outcry for aviation resources when they would be ineffective might lessen. Toward this end, we recommend that the Forest Service take appropriate action to enable fire managers to account for socio-political pressures for actions that would reduce cost efficiency.

Although the line officers and incident managers we interviewed stressed the complementary nature of ground and aviation resources, recent research, completed as part of the Performance Measures for Fire Fighting Enterprise, suggests a different interpretation.<sup>8</sup> This analysis reveals that

- The marginal productivity of crews, dozers, and engines was smaller on fires lasting more than 45 days relative to fires lasting less than 45 days.
- The marginal productivity of water drops was greater on fires lasting more than 45 days relative to shorter fires.
- The marginal productivity of crews was greater than the marginal productivity of water drops on fires lasting less than 45 days, but the reverse was true for longer fires.

These results suggest that aerial water drops can sometimes substitute for handcrews, for example, on longer duration fires. These results are not conclusive, however, as they do not currently account for variation in weather, fuel type, and other factors that can influence fire behavior, or for differences in the proximity of structures and other factors that can influence fire-suppression objectives.

## California Costs

Fire suppression costs seem higher in California than elsewhere. As we searched for an explanation of the difference, we found two important factors that influence these higher costs. Although both factors currently lead to higher costs in California, they sooner or later will have important implications for the costs of suppressing fires in other parts of the West. Accordingly, we recommend that the Forest Service increase its ability to measure the costs that might be avoided by renegotiating cost-sharing agreements with cooperating entities, especially in California.

First, we found evidence (from FY 2008 and past fire seasons) that suggests costs are higher in California because fires there are more complex and occur in more urbanized areas. Many national forest lands are adjacent to, or interspersed with, private, urbanized lands, where emergency first responders are organized and

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<sup>8</sup> This is preliminary work by Tom Holmes (USFS-SRS) estimating a Fire fighting Production Capability Function. He used data for FY 2008 fires greater than \$5 million in suppression costs and splitting the data into fires less than 45 days and fires greater than 45 days to estimate a Translog model where dependent variable is daily area contained. The results and model description are available from [tholmes@fs.fed.us](mailto:tholmes@fs.fed.us).

funded to meet urban needs. Fire management typically is more complex, and suppression costs higher in this wildland-urban interface area. Complexity and cost are even higher in areas where fuel loads are high. California is not an isolated case when it comes to wildland fire management in urban areas. Land management agencies will need to consider a wildland fire strategy that recognizes the interaction of wildlands, urban residents and urbanized emergency fire fighting services. Lessons learned from this examination can be useful in other areas.

Second, we found that, although state and local cooperators in California play crucial roles in suppressing fires that involve federal and other lands, cost-sharing agreements can be overly advantageous to them. This directly increases the Forest Service costs. Moreover, these agreements can reduce incentives for local cooperators to fight fires in a cost-efficient manner or to engage in fire-prevention activities. In California, federal fire suppression efforts rely heavily on state CAL FIRE and local fire department resources. CAL FIRE and local fire fighters can typically receive substantially higher pay than Forest Service staff. Local fire fighters have negotiated “portal to portal” compensation for 24 hours per day while on fire incident duty, costs that the Forest Service sometimes must bear under existing cost-share agreements. Additionally, local fire departments often collect substantial administrative fees when the Forest Service calls on one of their employees, as well as payment for replacement staff, even when no replacement staff is used and even though the employee continues to receive his or her salary in addition to fire incident salary and an overtime premium.

### **Large-Cost Fires and Overall Resource Usage**

The 22 wildfires with federal costs exceeding \$10 million utilized substantial shares of fire suppression resources during FY 2008. Based on ROSS daily resource use data, there were days for each California Geographic Area Coordination Center (GACC) when 80 percent or more of resources were in use by these fires. Table 3 provides the total share of resources used by the large fires while they were active for each GACC, as well as across these five GACCs for the entire FY 2008. Overall these fires utilized nearly half of aircraft, crews, and equipment during FY 2008 in these five GACCs.

**Table 3. Large-Cost Fire Resource Shares Relative to All Fires, by GACC**

GACC Name	Aircraft	Crew	Equipment	Overhead	Supply
CA-ONCC ( Jun 20, 2008–Oct 1, 2008)	60.6%	61.2%	39.5%	47.1%	46.3%
CA-OSSC ( Jun 1, 2008–Oct 1, 2008)	33.9%	41.2%	33.9%	38.1%	19.1%
CO-RMC ( Jul 26, 2008–Oct 15, 2008)	77.8%	75.7%	74.8%	75.9%	4.9%
NM-SWC ( Apr 15, 2008–May 14, 2008)	48.1%	12.9%	12.1%	10.6%	25.2%
OR-NWC ( Aug 8, 2008–Nov 7, 2008)	36.8%	17.7%	13.7%	12.9%	23.3%
All Five GACCs, entire FY 2008	40.3%	49.8%	42.5%	43.5%	37.0%

Source: ECONorthwest, with Daily ROSS data.

Note: Resources assigned to large-cost fires as a share of all resources in use among fires with incident codes. Based on resource counts, not costs.

## Other Cost Considerations

Two additional concerns warrant attention. One concern involves agency failure to consider, in a systematic and comprehensive manner, the non-financial costs of fire-suppression activities. These costs include the value of natural and cultural resources consumed or affected by fire and suppression activities. We recommend that the Forest Service take appropriate action to enable fire managers to account for the values of natural and cultural resources on federal land. Fire managers address some of these, but must do so without an assessment of their value. The absence of reliable, timely information about their value may seriously distort the cost efficiency of fire-suppression activities in situations where it exceeds the structural values that currently receive so much attention. A decision to divert a fire away from a structure, for example, might result in damage to natural and cultural resources worth more than the structure and more than what it would cost to protect these resources. Many of the costs will materialize in the future: keeping a fire from burning fuel today may increase the cost of fighting a future fire, for example.<sup>9</sup>

The other concern involves the cost of contract crews. Contract crews play differing roles in fire suppression activities from state to state. In Oregon, contract crew relationships and skills have developed over decades, and agency fire managers generally see them as cost efficient. The use of contract crews in Oregon permits the Forest Service to avoid training, liability and off-season costs. In other regions, the fire managers we interviewed generally expressed a preference for crews drawn from Forest Service employees and questioned potential cost savings.

<sup>9</sup> By suppressing fires that would consume fuel, the agency may, in some instances, be setting the stage for more costly fires in the future. Many critiques believe this is what has happened in the past and explains why we have the costs we do today. This assessment raises the possibility that, looking across multiple years, it may be cheaper, in the long run, to incur higher costs today, by managing fires so they consume fuel and avoid even higher costs in the future.

## **D. Act Promptly and Purposefully to Strengthen Forest Service Safety Culture**

The Forest Service espouses these strategic objectives: make decisions that emphasize safety; conduct cost-effective fire fighting; and develop success-oriented alternatives. However, line officers and incident managers have not consistently applied these strategic objectives when making tactical fire fighting decisions that concern safety. To address this situation, managers at all levels of the agency should take prompt and persistent action to establish and strengthen safety culture.

The regional large fire cost reviews, a recent survey of incident team members (Canton-Thompson et al. 2008), and our own interviews all indicate that agency ability to make progress on strategic objectives is compromised as incident managers receive what appears to be contradictory and inconsistent guidance. Accordingly, line officers and incident managers on the large wildland fires of 2008 did not act in a manner consistent with these objectives. Specifically we found that:

1. There appears to be a large gap between doctrine – which regards safety and cost control as Forest Service central values – and decision implementation on large fires. In particular, strategy selection for managing large fires does not appear to be strongly influenced by clear strategic guidance from top managers.
2. Too many individuals influencing large fire management decisions appear to anticipate that the use of new-and-improved decision tools can substitute for, or are more important than, a consistently applied (in a hierarchical fashion) set of principles that lead to the goal of safety and cost control.

The basis for these findings is discussed in Attachment 4. We have arrived at these observations in the context of trying to understand agency efforts to make the “best” decisions<sup>10</sup>. Throughout the various reviewed documents there is a prevalent focus on the need to make good decisions. A key attribute of good decisions is consistency between overarching goals and choices made regarding specific actions. In the case of wildland fire, good decision-making requires that strategic thinking at the broad (often national or multi-regional) scale is manifest in specific decisions made at the incident level.

Cost-efficient operations with the highest priority on safety – the Forest Service articulates these as its key values for large fire control. The selection of alternatives for fighting large fires in 2008 did consistently reflect these values.

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<sup>10</sup> See Attachment 4, section 2, which includes a summary of the concepts that comprise a good decision process.



However, the documentation of fire-management decisions does not indicate that line officers and incident managers understood the values clearly and acted on them uniformly. Our survey and assessment of the key factors that influenced selections of alternatives to control Region 5 large fires (see Section 3.3 Attachment 4) found that, generally, there was a large disparity between the agency expressed values and large fire decisions. Specifically, there was low application of the determinative criteria – promoting safety and reducing suppression costs – among fire-suppression alternatives.

This discrepancy between agency values and decisions emphasizes the importance of strengthening a safety culture within the Forest Service. A safety culture is achieved by establishing a hierarchy of goals, principles, and desired behaviors. If principles are followed, then agency goals are achieved and if individuals engage in desired behaviors, then the principles are followed. We recommend that the Forest Service take appropriate action to reinforce this hierarchy and strengthen its safety culture. Section 4, Attachment 4 describes a strategy for promulgating and disseminating a uniform set of organizational goals, principles, and desired behaviors, so that each individual understands, follows, and makes decisions that reflect the overall agency core values. We believe that there are opportunities to make decisions at the incident level that would be consistent with the agency goals and increase the probability of accomplishing both cost and safety objectives concurrently.

The statement of principles, by itself, cannot assure a safety culture throughout this decentralized agency. We recommend that the Forest Service develop a set of behaviors that, if followed, would apply the principles. We also recommend that it promote adoption of the behaviors through: training and procedures consistent with the principles; pervasive peer pressure; and comprehensive reporting of infractions of procedures, training and principles. The last should be accomplished without prejudice or the threat of retaliation.<sup>11</sup> Each national forest or incident management team should accept responsibility for using existing or instituting the means to achieve a safety culture and auditing its own progress. Each should have sufficient latitude to use tools, decision-making methods, management tactics, and organizational structures appropriate for its own circumstances. Of particular relevance, managers throughout the agency should resist the temptation to develop a decision tool intended to bring about agency-wide safe operation. Instead, they should recognize safe operation materializes as the sum total of behaviors that adhere to agency-established safety principles. A tool cannot substitute for a pervasive and dynamic culture of safety throughout the Forest Service.

Fire managers exhibit confusion about the merit of being risk-averse decision makers. We interpret this as an indication of agency shortcomings with regard to safety culture. This confusion causes some to conclude that increased safety

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<sup>11</sup> Detailed discussion of the means for achieving such behaviors is beyond the scope of this report. For an initial discussion, we recommend Chapter 9 (Engineering a Safety Culture) in Reason (1997).

necessarily entails a reduction in cost-efficiency. Most decision makers who select among alternatives that involve safety are risk averse. They will spend more money than the expected value of a loss to lower the number of injuries and fatalities. In other words, cost-efficiency entails incurring appropriate costs to achieve risk-averse, safety objectives. Section 2, Attachment 4 describes how a cogent decision process should simultaneously consider both the cost and the safety attributes of decision alternatives. With a clear understanding of the link between risk aversion and cost-efficiency, systematic application of the principles and behaviors of a safety culture (as suggested in Section 4, Attachment 4) will assure prudent, risk-averse behaviors and cogent decision processes that increase the probability of cost-efficient outcomes.

## **E. Provide a Coordinated System of Effective Incentives**

Well-designed incentives, both financial and non-financial, provide opportunities to influence fire management and suppression behaviors in ways that might reduce costs, maintain quality decision-making, and maintain safety for fire personnel and the public. Incentives can improve cost-efficiency by more properly aligning costs and benefits. In some cases, existing incentives, whether intentional or not, provide motivation for undesirable behavior. Rectifying these perverse incentives should be a priority.

Incentive opportunities exist at multiple scales for line officers and incident managers, for cooperating partner agencies, and for owners of local property and structures. Additional opportunities exist for correcting incentives for balancing the at-risk values of structures and private property with those of natural and cultural resources on federal lands. Provide predictable and consistent financial prizes for exemplary cost-effective decisions. Renegotiate cost-sharing agreements so cooperators have stronger incentives to reduce federal costs. Increase incentives for property owners to reduce fire risks. Reduce incentives to protect structures and private property to the detriment of natural and cultural resources on federal lands.

Our recommendations for incentives are based on interviews, primarily with Forest Service personnel, and cost-sharing documentation. While we found no documented evidence of cooperators or Forest Service personnel intentionally using resources inefficiently, we did encounter evidence that some existing incentives might encourage them to do so. Whether or not there is evidence of acting on perverse incentives, such incentives should be rectified as described below. Implementation would likely benefit from consideration of non-federal perspectives as well.

**Incentives for officers and commanders.** The Forest Service does have the ability to financially award individuals, and has done so in the past. Prizes have been used in all manner of fields to spur innovation and exemplary behavior. Prize incentives can leverage the value of recognition combined with a financial reward. Accordingly, we recommend that the Forest Service provide predictable



and consistent financial prizes for exemplary cost-effective decisions. Such individual incentives can highlight the importance of individual effort and successful strategies when carefully targeted for specific behaviors and outcomes. In order to influence behavior, it is important that individual prizes and incentives are well-publicized and consistently administered. In some cases non-financial incentives might be as effective, particularly when reducing existing costs for individuals.

**Incentives for cooperating partner agencies.** Decisions by cooperating agencies influence overall costs and costs borne by federal agencies. When cooperating agencies receive revenue from the federal government as the result of local resource-use for fire suppression, cooperators have a financial incentive to charge high rates and increase the use of resources. This particularly holds for charges beyond the direct costs of time and materials such as administrative fees or overhead charges on personnel time. Interviews suggest that the Forest Service bears substantial costs from suppression efforts to protect non-federal land and non-federal structures. If cooperators more directly bear these costs, they would have more appropriate incentives for cost management. We recommend that the Forest Service take appropriate action to renegotiate cost-sharing agreements so cooperators have stronger incentives to reduce federal and overall costs.

**Incentives for local property and structure owners.** Quantitative studies, including those generating the Stratified Cost Index, and interviews reveal the strong influence of private property on federal fire suppression costs. Development in fire-prone areas has increased at the same time that climatic and other biophysical factors are expanding fire-prone areas. If private land and structure owners bear more direct cost for protection of their property, they are likely to take on behaviors to reduce fire risk, such as management of defensible space and home site selection. We recommend that the Forest Service take appropriate action to increase incentives for state and local government and private property owners to reduce fire risks. For example, this should influence behavior and development in the Wildland-Urban Interface. This cost alignment might be done directly or by increasing local cooperator cost responsibility.

**Incentives for non-market resources.** The RAVAR tool captures values for built structures, but does not capture cultural, natural resource, or other non-market values. This creates a management incentive to emphasize built resources and deemphasize others. Decision tools that measure values should account for all valuable resources so that they can help identify appropriate incentives for suppression effort allocation. We recommend that the Forest Service take appropriate action to reduce incentives to protect structures and private property to the detriment of natural and cultural resources on federal lands.

## F. Improve the Stratified Cost Index

The Stratified Cost Index (SCI) is a cost performance measure fire personnel use to judge the cost-effectiveness of their fire-control efforts for fires larger than 300 acres. The SCI is the predicted per-acre suppression expenditures for the fire of interest, based on actual expenditures on previous fires with similar attributes. These attributes include location (Forest Service Region), fire size, predominant fuel types, fire intensity, energy release component (weather conditions), terrain (slope and aspect), total housing values within five and twenty miles, and whether the fire is located within a wilderness area, roadless area or other specially designated area.

The SCI currently has two purposes. First, it calculates a long-run measure of cost containment. Second, it provides a metric against which fire managers can compare their estimated suppression cost. This information helps fire personnel assess the cost-effectiveness of their proposed fire-suppression plan.

The SCI is used to identify fires whose actual expenditures exceeded “benchmark” expenditures by more than one standard deviation. The percentage of fires within one standard deviation provides a rough measure of the effectiveness of Forest Service cost containment efforts. Such fires are also likely candidates for further cost review after the fire season has ended. For this purpose, the SCI benchmark value is derived from a data set consisting of all fires from 1995 to 2004. Used in this capacity, the SCI provides interesting insights into large fire costs. For example, Table A6 depicts FY 2008 fires ranked in order of total cost. For all large fires (those in excess of \$10 million), the actual per acre suppression costs exceeded the predicted SCI costs. In other words, the unexplained variation is positive for all of these fires – statistically a very unlikely event. While this may be a bias in the model, it may also reflect the behavior of the fire managers on those fires. As total costs soar, incremental costs of various activities may seem relatively minor to the incident managers and so escape the scrutiny they would receive on less expensive fires. By identifying this tendency, it may be possible to reduce fire costs in the future. This could be due to less scrutiny, or it could be due to a judgmental bias introduced when cost increments are evaluated relative to the base of costs already incurred. If so, the result would be a discounting of incremental costs as total costs increase.

The SCI is used as a real time cost metric to provide feedback to fire personnel for assessing the cost-effectiveness of their fire suppression efforts. For this purpose, the SCI is derived from recent fires only (within the past five years) and is updated as the fire progresses in light of changing conditions. In this capacity, the SCI is a component of the WFDSS. In practice, incident managers recognize the inherent variability in fire suppression costs and use the SCI primarily as a talking point for discussion unless current suppression costs substantially exceed the SCI. Based on the cost reviews of large fires prepared by the four regions with one or more fires with suppression costs exceeding \$10 million, and our discussions with Forest Service personnel, the tipping point is somewhere in the neighborhood of the 75 percent threshold, i.e., 75 percent of similar fires would

have lower suppression costs than those currently for this fire. In general, below this point costs are perceived as within acceptable limits. Above this point, the incident managers take a harder look at the cost-effectiveness of the actions under consideration. Similarly, the probability of some regional oversight increases as the amount that current fire suppression costs exceed the SCI increases.

The high variability in fires and fire suppression costs generates limitations for the SCI. Accordingly, we recommend that the Forest Service incorporate into the SCI appropriate data so it better represents spatially explicit variation in fire-suppression costs. Fires with very similar attributes can still differ in very significant ways. Similarly, costs for specific fire suppression activities can differ substantially in different circumstances. Consequently, accounting for this variability in any simple metric is problematic at best.<sup>12</sup> Indeed, the regression models underlying the SCI account for approximately 50 percent of the variation in fire costs, after accounting for many of the known differences between fires. Thus, large variations about the SCI should be expected. In light of this, the SCI is best suited for its role as a long-run performance metric, where performance on a group of fires, not a specific fire, is being evaluated. Consequently, it should be used cautiously as a real time metric of performance on individual fires. Indeed, fire personnel implicitly or explicitly recognized this limitation of the SCI in 2008, which explains the relatively high threshold discussed above.

More problematic are the social and human factors that impact costs. During interviews with Forest Service fire personnel, the most frequently cited factor contributing to greater-than-predicted expenditures was political pressure at the local level. Once a fire had “gone political” incident managers were substantially more likely to employ aggressive methods to suppress fires, regardless of cost.

Better training in the meaning and the role of the SCI in fire suppression efforts is needed. Comments by fire personnel and statements in the Regional Large Fire Cost Reviews suggest that some misconceptions about the SCI exist. References to “keeping costs between the 25 percent and 75 percent thresholds,” or “using the SCI as a reference fire budget” are examples. The SCI can provide useful information to fire personnel but can easily be misused or misinterpreted.

## **G. Improve the Effectiveness of Review/Oversight Processes**

Over the past decade, the Forest Service and other federal land management agencies have received numerous recommendations targeting wildland fire

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<sup>12</sup> Efforts are currently underway to improve the SCI in several ways. As better data become available, the models are being made more spatially explicit. For example, suppression costs are more closely linked to the length of defensible fire line needed to contain the fire, rather than the size of the fire. With good fire perimeter data, better, more relevant cost estimates are possible. Other spatially explicit information, such as stand types, fuel loads, and locations of previous burns, may also prove useful in improving model results.

costs. It is apparent from the background material we reviewed that positive change in the conditions and causes impacting wildland fire costs has been elusive (see Attachment 3 for details). The internal and external reviews, from independent panels to the Quadrennial Fire Reviews, have essentially described similar causes and conditions and recommendations for action. The most recent strategic plan and budget justification for the Forest Service reflects a number of these causes and conditions, but it is also evident that means and strategies over the past many years tell a story of limited progress. This suggests to us that either the recommendations are not valid and cannot be feasibly implemented, or that the Forest Service and other federal land management agencies need to refresh their approach in managing implementation of the recommendations and demonstrating the operational results.

The vast majority of recommendations from these reviews remains appropriate, particularly in tackling underlying conditions and causes that impact costs before and during a fire season. We believe that action should be taken to strengthen the current Forest Service management decision process to create a line of sight from conditions and causes to action to performance to assessment. Performance measures should directly reflect prevention and/or mitigation of causes. The 2009 QFR and the Ten Year Comprehensive Strategy and the Strategy's latest implementation plan might serve as foundational documents in this effort, including better targeting of performance measures for wildfire results management. Performance measures should directly reflect mitigation of causes, and emphasize outcomes over output and process measures. Such an approach should strengthen the current operating standards used by the Forest Service for planning its work, reporting its accomplishments, and developing follow-on work programs and individual projects.

In addition, we have come to believe that the current framework of wildfire cost and management reviews should be replaced with a streamlined, rigorous, and targeted approach taking advantage of internal and external reviews. These reviews would assess strategic and operational actions continuously before, during, and after a fire season, and aim to facilitate both immediate and longer-term decision-making. Pre-fire season reviews might assess the magnitude of impact to be expected from actions such as the work of NIMO teams in planning and exercising partners or in the reducing of hazardous fuels in priority areas. During the fire season, reviews should scrutinize the definition of rules of engagement, the consideration of alternative strategies, and the selection of the most appropriate strategy. A lesser priority might apply to reviews after a fire or fire season, simply because the context of decision-making often is lost or re-interpreted, after the season has ended. Reviews after a fire or fire season should not attempt to deconstruct decisions or costs, but instead identify better practices that might be applied during the next fire event or season. The results of all reviews and any actions to implement the recommendations should be provided to future independent review panels.

We believe that the current situation causes cost-review fatigue which significantly inhibits analytical insight and appropriate corrective actions. Recommendations from the existing review processes generally do not result in actions that drive useful organizational changes. In practice, fire reviews do not follow a complete set of standard performance audit and review practices. As a result of these three conditions, we recommend that the Forest Service consider the benefits of a more streamlined, rigorous, and targeted approach that coordinates internal and external reviews before, during, and after a fire season.<sup>13</sup> Such action would acknowledge the importance of performance reviews as critical management tools to identify emerging needs, drive accountability, and reinforce organizational change, including the adoption of new tools and best practices.

## IV. EMERGING ISSUES

We began our investigation by looking at questions of fiscal diligence in the context of large individual fires and came to realize that it is a sub-component of a larger problem. We found three broad areas of determining influences. The first is suppression costs and actions being taken to reduce costs on individual fires and across large landscapes and multiple years. The second set of factors deal with the benefits of fire and fire suppression. The third set of factors are those that set the context for fire occurrence and suppression.

During our investigation we identified several emerging issues related to these three areas of determining influences that we anticipate will have significant impact on the suppression costs of future wildland fires. Here, we briefly describe these issues and encourage Fire and Aviation Management to ask future Independent Panels to examine them more closely. These include:

### **Changing conditions for fire occurrence and suppression**

Fuels, development patterns, water availability, climate change and other related factors are believed by many to be changing the occurrence and behavior of wildland fires. These factors might be cyclical or the result of general trends. How these co-incidental changes affect suppression costs and strategies is not fully understood.

### **Cost-sharing agreement framework and guidelines**

Cost sharing agreements hold the potential to greatly influence federal and overall suppression costs, as well as providing an opportunity for incentives to other parties that impact cost. Local and state-level cost-sharing agreements could benefit from general guidelines, and might provide a means to influence private behaviors.

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<sup>13</sup> An example of such an improved review and follow-up process is described in Attachment 5.

### **Impacts of decision-support tools on behavior**

While decision-support tools are becoming increasingly sophisticated and experiencing growing usage, their impact on actual behaviors is unclear. The decision tools are intended to change behaviors, but actual impact on behavior and potential for unintended consequences is unknown. Expanding and presenting WFDSS outputs to provide information about benefits of various suppression strategies would improve cost-effectiveness. The success of the pre-season training by NIMO teams should be a topic for future review.

### **Managing a standing fire-fighting function within a land-management agency**

As the Forest Service budget increasingly goes to fire management, are current training programs, roles, and institutional systems adequate, considering they were put in place for land management?

### **Post-containment expenditures**

Some interviewees expressed a concern that post-containment expenditures for mop-up and rehabilitation could be a disproportionately large share of the costs. Current systems do not allow isolation of these costs for consideration.

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## PANELIST BIOGRAPHIES

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Dr. Sharon Caudle is the Younger-Carter Distinguished Policymaker in Residence at The Bush School of Government & Public Service at Texas A&M University. Formerly, Dr. Caudle was an assistant director for homeland security with the U.S. Government Accountability Office's (GAO) Homeland Security and Justice Team. She specialized in homeland security, strategic policy and management issues. Her current work involves catastrophic disaster lessons learned from Hurricane Katrina, national preparedness performance expectations, and regional strategic planning. In addition her work with GAO, Dr. Caudle has extensive government headquarters and field experience with the U.S. Office of Management and Budget, Department of Agriculture (Food Stamp Program and Women, Infants, and Children's Supplemental Feeding Program), and the State of Nevada in social services and quality control.

She earned her masters and doctorate in public management from The George Washington University in Washington, DC. Dr. Caudle also earned a master's in homeland security and homeland defense from the School of International Studies, Naval Postgraduate School, in Monterey, CA. She is a senior fellow with The George Washington University's Homeland Security Policy Institute, a member of the American National Standards Institute Homeland Security Standards Panel steering committee, and a member of the technical committee for the national preparedness standard NFPA 1600.

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Dr. Michael V. Frank is currently Manager of Preclosure Safety Analysis at Bechtel SAIC LLC. During 35 years of experience, he has authored approximately 90 technical publications in the areas of risk analysis and reliability with respect to terrestrial nuclear power, space-nuclear missions, aerospace systems, nuclear waste repositories, and other ground facilities, and has made hundreds of presentations in national and international forums. His particular expertise is the assessment and management of all risks associated with the design and operation of engineered systems and the decision-making that accompanies risk management.

Dr. Frank received his Ph.D. in Engineering from UCLA. He is a Professional Nuclear Engineer with an educational background in mechanical engineering, nuclear engineering, and material science as well as reliability and risk analysis. He has served on NASA's Space Shuttle PRA review board and risk assessment software review board, is the former President of the Forensic Consultants



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Until his recent retirement, Dr. Haynes was Program Manager and Chief Economist for the Social and Economic Values Research Program at the Pacific Northwest Research Station, U.S. Forest Service. He also has an adjunct appointment (Associated Professor, Professor) in the Department of Forest Resources, Oregon State University and had an adjunct appointment (Professor) in the College of Forest Resources, University of Washington from 1984 to 2007. He specializes in Forest Marketing, Trade, and Policy Research.

Dr. Haynes received his Ph.D. in Forest Economics from North Carolina State University. He belongs to several honorary societies including Alpha Zeta (Agricultural Honorary), Xi Sigma Pi (Forestry Honorary), and Omicron Delta Epsilon (Economics Honorary). He has twenty five Certificates of Merit or Appreciation for research innovations, research leadership, and research management (human development), a USDA Superior Service Award, a Forest Science Award from the Society of American Foresters, and a Distinguished Science Award from the USDA Forest Service.

**Dr. Ian Munn**

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Dr. Ian Munn is a Professor of Forestry at Mississippi State University. He specializes in natural resource/forest economics, forest management, and applied microeconomics. He teaches in Professional Practices and Advanced Forest Resource Management and Planning at MSU. His current research focuses on woody biomass, the impact of the forest products industry on the post-Katrina Mississippi economy, and ecological and economic determinants of invasive tree species on Alabama forestland.

Dr. Munn received his Ph.D. in Forestry and Economics (co-major) from North Carolina State University. He is the Editor of the Southern Journal of Applied Forestry, a member of the Society of American Foresters, the Mississippi Forestry Association, the American Agricultural Economics Association, the American Economic Association, the Southern Economic Association, and the Southern Forest Economics Workers. He is a part of several honor societies including Xi Sigma Pi (Forestry Society), Gamma Sigma Delta (Agriculture Society), and the Phi Kappa Phi Honor Society (North Carolina State University). He received an outstanding Service Award from the College of Forest Resources and an Outstanding Research Award from the Forest and Wildlife Research Center.

**Ernest G Niemi**

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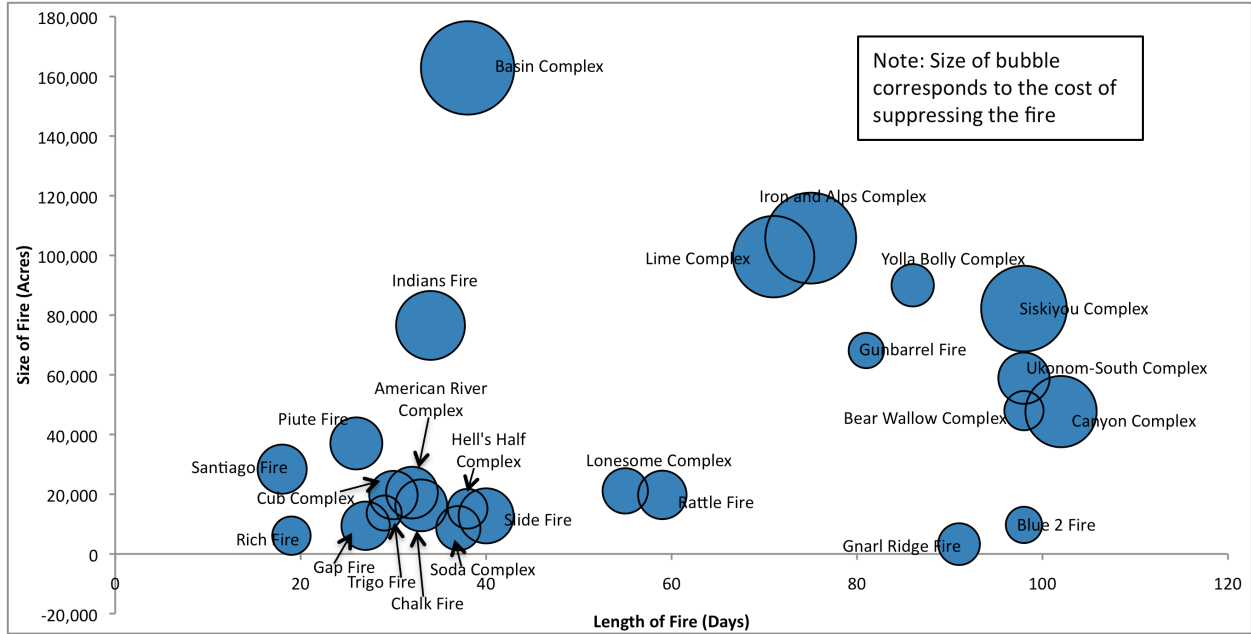
Ernie Niemi has been a vice president and senior policy analyst at ECONorthwest since 1978. He specializes in applying the principles of cost-benefit analysis, economic valuation, and economic-impact analysis in the context of natural-resource management, economic development, and public-policy decisions. He has presented analytical findings to congressional, judicial, arbitrate, administrative, and scientific/professional bodies. He has worked on many natural-resource projects throughout the western U.S. These have entailed describing the values associated with alternative uses of natural resources and estimating how local and regional economies respond to changes in these uses. He has worked on numerous, multi-state projects that involved describing the economic consequences of forest ecosystem services and other resources. He is currently working on the analysis of the proposed transmission line through Idaho and Montana.

Ernie Niemi has a Master's of Community and Regional Planning in Urban Planning and Public Policy from Harvard University. Based on his experience, he often is invited to give presentations on the economics of water management; recent events include the North American Reservoir Symposium, the Western States Water Council, and Dividing the Waters (a conference for judges, masters, and referees involved in western stream adjudications and complex water litigation).

## **ATTACHMENT 1. SUPPLEMENTAL TABLES**

- Figure A1. Fiscal Year 2008 Large Wildfires by Length of Fire, Size of Fire, and Cost of Fire**
- Figure A2. Map of Fiscal Year 2008 Wildfires with an Incident Code**
- Table A1. Weekly Cost Summary for All Fiscal Year 2008 Large Wildfires**
- Table A2. Summary of Fires by Complex, Teams, and Jurisdictions**
- Figure A3. Daily Disaggregated Costs by Incident**
- Figure A4. Suppression Costs by Category for Fiscal Year 2008 Large Wildfires**
- Table A3. Disaggregated Costs of Each Incident Estimated by I-Suite Data**
- Figure A5. Shares by Cost Category, Fiscal Year 2008 Large Wildfires**
- Table A4. Disaggregated Costs of Each Incident, by Percent**
- Table A5. Total Cost Comparison by I-Suites Estimate, Actual Cost, and 209 Estimate**
- Table A6. Actual Versus Stratified Cost Index Predicted Costs/Acre for Fiscal Year 2008 Fires Exceeding \$10 Million in Total Expenditures**

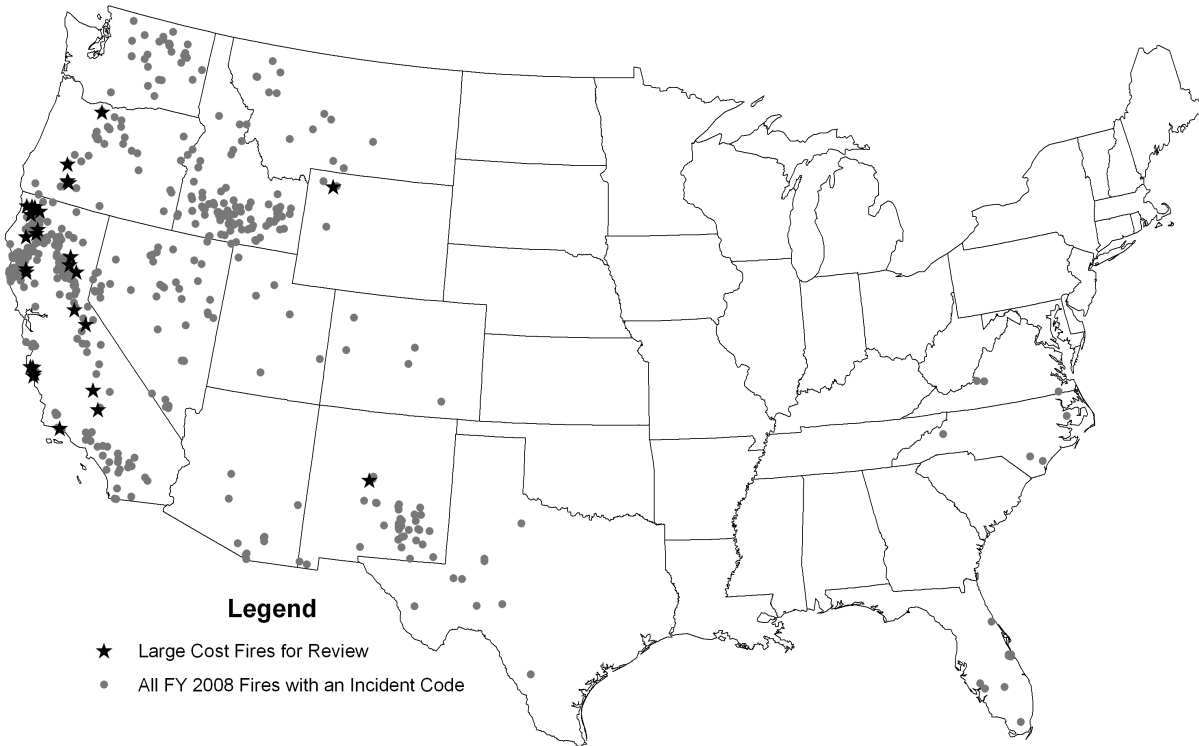
**Figure A1. Fiscal Year 2008 Large Wildfires by Length of Fire, Size of Fire, and Cost of Fire**



Source: ECONorthwest, with data from ICS-209 Database, InciWeb Incident Information System

Notes: The original list of 26 incidents is reduced to 22 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater.

**Figure A2. Map of Fiscal Year 2008 Wildfires with an Incident Code**



Source: Watershed Professionals Network with data from the Resource Ordering and Status System (ROSS)

**Table A1. Weekly Cost Summary for All Fiscal Year 2008 Large Wildfires**

Date	Aircraft	Camp Support	Crews	Equipment	Personnel	Supplies	Total
<b>American River Complex</b>							
21-Jun	\$99,183	\$365,548	\$351,162	\$205,218	\$458,339	\$22,200	\$1,501,650
28-Jun	\$901,537	\$1,406,682	\$906,216	\$657,475	\$982,191	\$222,180	\$5,076,281
05-Jul	\$1,025,060	\$2,333,128	\$1,329,485	\$1,513,164	\$1,611,232	\$328,980	\$8,141,050
12-Jul	\$1,181,311	\$2,176,918	\$1,428,393	\$1,312,303	\$1,687,269	\$382,745	\$8,168,939
19-Jul	\$416,235	\$1,562,051	\$656,533	\$630,586	\$878,840	\$242,155	\$4,386,399
26-Jul	\$118,168	\$341,121	\$97,494	\$142,625	\$224,095	\$58,500	\$982,003
02-Aug	\$8,209	\$98,230	\$50,319	\$35,065	\$60,914	\$0	\$252,738
09-Aug	\$0	\$16,432	\$0	\$14,182	\$5,373	\$0	\$35,987
16-Aug	\$0	\$10,842	\$0	\$0	\$0	\$0	\$10,842
<b>Total</b>	<b>\$3,749,702</b> (13.1%)	<b>\$8,310,952</b> (29.1%)	<b>\$4,819,603</b> (16.9%)	<b>\$4,510,618</b> (15.8%)	<b>\$5,908,253</b> (20.7%)	<b>\$1,256,760</b> (4.4%)	<b>\$28,555,889</b>
<b>Basin Complex</b>							
21-Jun	\$1,151,914	\$1,157,969	\$1,171,467	\$1,804,801	\$805,512	\$182,434	\$6,274,097
28-Jun	\$2,803,239	\$3,394,566	\$2,012,250	\$4,988,885	\$1,919,102	\$573,017	\$15,691,060
05-Jul	\$6,211,313	\$6,135,172	\$2,408,861	\$6,000,052	\$2,673,295	\$815,446	\$24,244,139
12-Jul	\$3,477,672	\$6,033,188	\$3,582,938	\$3,075,197	\$4,317,133	\$1,176,506	\$21,662,633
19-Jul	\$2,224,816	\$4,475,206	\$2,898,810	\$2,966,116	\$4,003,991	\$808,024	\$17,376,963
26-Jul	\$250,976	\$2,625,144	\$636,976	\$1,286,887	\$1,412,826	\$164,389	\$6,377,198
02-Aug	\$122,416	\$1,021,675	\$191,114	\$486,797	\$575,688	\$14,500	\$2,412,191
09-Aug	\$15,127	\$121,448	\$108,038	\$73,447	\$201,003	\$1,500	\$520,563
<b>Total</b>	<b>\$16,257,471</b> (17.2%)	<b>\$24,964,369</b> (26.4%)	<b>\$13,010,455</b> (13.8%)	<b>\$20,682,182</b> (21.9%)	<b>\$15,908,550</b> (16.8%)	<b>\$3,735,816</b> (4.0%)	<b>\$94,558,843</b>
<b>Canyon Complex</b>							
21-Jun	\$173,619	\$1,144,271	\$1,672,240	\$1,143,053	\$1,345,888	\$175,183	\$5,654,254
28-Jun	\$595,282	\$1,814,506	\$2,171,844	\$1,852,561	\$1,806,232	\$416,423	\$8,656,849
05-Jul	\$441,349	\$2,194,896	\$2,519,367	\$2,016,903	\$2,116,481	\$611,030	\$9,900,026
12-Jul	\$679,414	\$2,156,231	\$2,942,984	\$2,215,730	\$2,479,473	\$522,154	\$10,995,986
19-Jul	\$969,544	\$2,508,421	\$2,623,100	\$2,037,164	\$2,606,670	\$507,164	\$11,252,062
26-Jul	\$557,207	\$2,280,691	\$969,393	\$1,203,736	\$1,644,520	\$298,786	\$6,954,333
02-Aug	\$303,534	\$2,014,858	\$247,519	\$735,730	\$608,589	\$262,419	\$4,172,649
09-Aug	\$14,541	\$76,664	\$0	\$45,794	\$23,058	\$16,800	\$176,857
<b>Total</b>	<b>\$3,734,490</b> (6.5%)	<b>\$14,190,538</b> (24.6%)	<b>\$13,146,446</b> (22.8%)	<b>\$11,250,670</b> (19.5%)	<b>\$12,630,912</b> (21.9%)	<b>\$2,809,958</b> (4.9%)	<b>\$57,763,014</b>
<b>Chalk</b>							
27-Sep	\$3,062,305	\$1,903,592	\$1,633,915	\$2,020,564	\$2,406,127	\$50,000	\$11,076,503
04-Oct	\$1,024,993	\$2,484,534	\$1,565,771	\$2,486,324	\$3,036,386	\$70,000	\$10,668,009

Date	Aircraft	Camp Support	Crews	Equipment	Personnel	Supplies	Total
11-Oct	\$1,192,327	\$578,173	\$393,299	\$977,350	\$1,083,425	\$40,000	\$4,264,574
18-Oct	\$1,235,386	\$1,681,477	\$821,728	\$1,574,436	\$2,026,800	\$60,000	\$7,399,827
25-Oct	\$153,852	\$741,817	\$287,583	\$796,690	\$954,762	\$12,000	\$2,946,703
01-Nov	\$28,650	\$13,971	\$10,080	\$231,196	\$227,280	\$0	\$511,178
<b>Total</b>	<b>\$6,697,512</b> (18.2%)	<b>\$7,403,566</b> (20.1%)	<b>\$4,712,375</b> (12.8%)	<b>\$8,086,560</b> (21.9%)	<b>\$9,734,780</b> (26.4%)	<b>\$232,000</b> (0.6%)	<b>\$36,866,794</b>

**Cub Complex**

22-Jun	\$184,267	\$595,981	\$1,063,182	\$469,620	\$636,777	\$142,825	\$3,092,652
29-Jun	\$250,905	\$1,320,226	\$1,248,776	\$1,367,788	\$1,082,119	\$217,487	\$5,487,301
06-Jul	\$948,578	\$1,513,126	\$1,591,452	\$1,943,648	\$1,475,497	\$126,939	\$7,599,240
13-Jul	\$573,893	\$1,714,066	\$2,081,359	\$1,570,592	\$1,623,952	\$101,940	\$7,665,802
20-Jul	\$19,188	\$439,775	\$225,470	\$278,019	\$288,844	\$4,726	\$1,256,021
<b>Total</b>	<b>\$1,976,830</b> (7.9%)	<b>\$5,583,174</b> (22.2%)	<b>\$6,210,240</b> (24.7%)	<b>\$5,629,667</b> (22.4%)	<b>\$5,107,189</b> (20.3%)	<b>\$593,917</b> (2.4%)	<b>\$25,101,017</b>

**Gap**

01-Jul	\$3,083,361	\$1,077,886	\$1,058,698	\$6,119,401	\$498,963	\$333,576	\$12,171,884
08-Jul	\$1,575,000	\$1,670,118	\$1,258,831	\$3,271,018	\$898,355	\$624,101	\$9,297,423
15-Jul	\$31,228	\$341,457	\$229,610	\$49,501	\$222,046	\$20,000	\$893,842
22-Jul	\$1,600	\$12,154	\$74,436	\$1,032	\$38,436	\$0	\$127,658
<b>Total</b>	<b>\$4,691,189</b> (20.9%)	<b>\$3,101,615</b> (13.8%)	<b>\$2,621,574</b> (11.7%)	<b>\$9,440,952</b> (42.0%)	<b>\$1,657,799</b> (7.4%)	<b>\$977,677</b> (4.3%)	<b>\$22,490,806</b>

**Gnarl Ridge**

15-Sep	\$1,837,435	\$1,969,125	\$2,725,660	\$691,255	\$1,758,212	\$556,634	\$9,538,322
22-Sep	\$465,490	\$1,114,026	\$1,437,738	\$624,754	\$2,025,899	\$191,490	\$5,859,397
29-Sep	\$224,134	\$734,985	\$532,685	\$372,648	\$716,843	\$155,885	\$2,737,179
<b>Total</b>	<b>\$2,527,059</b> (13.9%)	<b>\$3,818,136</b> (21.1%)	<b>\$4,696,083</b> (25.9%)	<b>\$1,688,657</b> (9.3%)	<b>\$4,500,954</b> (24.8%)	<b>\$904,009</b> (5.0%)	<b>\$18,134,898</b>

**Gunbarrel**

26-Jul	\$262,321	\$131,401	\$66,150	\$35,595	\$243,996	\$7,314	\$746,777
02-Aug	\$1,030,314	\$755,211	\$468,840	\$328,281	\$944,127	\$87,619	\$3,614,392
09-Aug	\$401,076	\$534,809	\$245,469	\$193,377	\$501,921	\$47,260	\$1,923,913
16-Aug	\$227,775	\$399,029	\$320,998	\$196,191	\$458,231	\$37,609	\$1,639,832
23-Aug	\$712,622	\$272,009	\$265,424	\$190,305	\$384,530	\$20,787	\$1,845,677
<b>Total</b>	<b>\$2,634,108</b> (27.0%)	<b>\$2,092,459</b> (21.4%)	<b>\$1,366,881</b> (14.0%)	<b>\$943,749</b> (9.7%)	<b>\$2,532,806</b> (25.9%)	<b>\$200,589</b> (2.1%)	<b>\$9,770,591</b>

**Hell's Half Complex**

20-Jun	\$12,566	\$336,620	\$410,208	\$246,713	\$335,339	\$220	\$1,341,666
27-Jun	\$54,749	\$688,879	\$464,256	\$483,100	\$477,636	\$74,778	\$2,243,397
04-Jul	\$175,081	\$752,044	\$564,194	\$542,517	\$554,904	\$119,191	\$2,707,931
11-Jul	\$111,308	\$1,168,030	\$750,299	\$1,317,745	\$975,528	\$164,904	\$4,487,813



Date	Aircraft	Camp Support	Crews	Equipment	Personnel	Supplies	Total
18-Jul	\$115,484	\$1,406,437	\$674,420	\$928,480	\$868,371	\$162,324	\$4,155,515
25-Jul	\$23,253	\$1,127,191	\$123,148	\$484,297	\$490,369	\$187,680	\$2,435,937
<b>Total</b>	<b>\$492,440</b> (2.8%)	<b>\$5,479,199</b> (31.5%)	<b>\$2,986,525</b> (17.2%)	<b>\$4,002,851</b> (23.0%)	<b>\$3,702,147</b> (21.3%)	<b>\$709,097</b> (4.1%)	<b>\$17,372,259</b>

**Indians**

08-Jun	\$3,538,735	\$2,286,489	\$2,102,069	\$2,966,541	\$3,082,816	\$203,200	\$14,179,849
15-Jun	\$2,773,584	\$3,902,299	\$3,191,052	\$5,405,936	\$3,764,660	\$505,857	\$19,543,387
22-Jun	\$1,550,832	\$3,306,204	\$2,227,196	\$3,556,993	\$2,092,964	\$404,714	\$13,138,902
29-Jun	\$355,577	\$2,084,509	\$489,274	\$1,229,748	\$466,608	\$291,508	\$4,917,224
06-Jul	\$0	\$72,861	\$38,764	\$210,827	\$195,225	\$62,705	\$580,382
13-Jul	\$0	\$1,750	\$0	\$141,960	\$163,080	\$0	\$306,790
<b>Total</b>	<b>\$8,218,728</b> (15.6%)	<b>\$11,654,112</b> (22.1%)	<b>\$8,048,355</b> (15.3%)	<b>\$13,512,004</b> (25.7%)	<b>\$9,765,352</b> (18.5%)	<b>\$1,467,984</b> (2.8%)	<b>\$52,666,535</b>

**Iron & Alps Complex**

20-Jun	\$145,085	\$790,216	\$632,344	\$363,780	\$631,271	\$130,966	\$2,693,661
27-Jun	\$238,032	\$1,458,105	\$1,292,737	\$1,584,945	\$1,430,172	\$306,195	\$6,310,186
04-Jul	\$348,080	\$1,898,594	\$1,672,704	\$1,651,202	\$1,714,522	\$322,668	\$7,607,770
11-Jul	\$391,718	\$2,606,673	\$2,051,743	\$1,583,525	\$2,007,266	\$276,522	\$8,917,447
18-Jul	\$818,891	\$3,048,494	\$2,726,885	\$2,795,241	\$2,686,783	\$355,382	\$12,431,676
25-Jul	\$1,397,219	\$3,009,492	\$2,802,821	\$2,790,028	\$2,420,389	\$561,554	\$12,981,503
01-Aug	\$1,330,958	\$2,709,209	\$2,575,611	\$1,357,199	\$1,721,538	\$516,391	\$10,210,906
08-Aug	\$1,047,197	\$2,315,241	\$2,138,066	\$1,463,162	\$1,964,075	\$409,005	\$9,336,747
15-Aug	\$598,023	\$2,325,632	\$1,524,966	\$1,515,836	\$1,880,758	\$354,180	\$8,199,395
22-Aug	\$278,231	\$1,253,908	\$724,181	\$612,615	\$689,324	\$260,132	\$3,818,390
29-Aug	\$199,043	\$760,162	\$185,961	\$280,293	\$270,664	\$112,361	\$1,808,484
05-Sep	\$72,500	\$120,832	\$132,774	\$193,063	\$164,335	\$77,429	\$760,934
12-Sep	\$16,740	\$48,980	\$90,296	\$120,370	\$64,283	\$14,681	\$355,349
19-Sep	\$6,781	\$13,878	\$0	\$35,913	\$20,089	\$128,984	\$205,645
26-Sep	\$0	\$740,629	\$0	\$29,666	\$11,760	\$10,917	\$792,972
03-Oct	\$0	\$0	\$0	\$22,626	\$11,760	\$769	\$35,155
10-Oct	\$0	\$0	\$0	\$22,626	\$11,760	\$0	\$34,386
17-Oct	\$0	\$0	\$0	\$17,346	\$11,760	\$878	\$29,984
24-Oct	\$0	\$0	\$0	\$2,478	\$1,680	\$0	\$4,158
<b>Total</b>	<b>\$6,888,498</b> (8.0%)	<b>\$23,100,044</b> (26.7%)	<b>\$18,551,090</b> (21.4%)	<b>\$16,441,913</b> (19.0%)	<b>\$17,714,189</b> (20.5%)	<b>\$3,839,015</b> (4.4%)	<b>\$86,534,749</b>

**Klamath Theater**

20-Jun	\$286,588	\$968,901	\$919,031	\$613,912	\$907,219	\$133,743	\$3,829,394
27-Jun	\$476,045	\$1,804,579	\$1,631,681	\$1,112,454	\$1,591,956	\$321,066	\$6,937,781
04-Jul	\$591,018	\$2,057,899	\$1,841,678	\$1,120,197	\$1,757,728	\$490,340	\$7,858,861
11-Jul	\$940,568	\$2,986,376	\$2,787,719	\$2,187,117	\$2,825,389	\$644,451	\$12,371,620

Date	Aircraft	Camp Support	Crews	Equipment	Personnel	Supplies	Total
18-Jul	\$1,328,607	\$4,142,756	\$4,386,036	\$2,616,513	\$4,256,511	\$925,192	\$17,655,615
25-Jul	\$1,528,334	\$5,276,699	\$4,555,606	\$3,695,047	\$5,920,444	\$875,162	\$21,851,292
01-Aug	\$1,817,412	\$6,841,401	\$6,265,624	\$3,978,522	\$7,067,421	\$1,508,478	\$27,478,858
08-Aug	\$1,230,448	\$6,410,060	\$4,568,437	\$2,805,809	\$5,154,154	\$1,247,649	\$21,416,557
15-Aug	\$844,031	\$3,895,935	\$1,834,674	\$1,313,171	\$2,509,340	\$864,972	\$11,262,124
22-Aug	\$1,002,890	\$2,616,570	\$1,152,118	\$913,111	\$1,578,933	\$621,191	\$7,884,812
29-Aug	\$546,605	\$1,745,137	\$707,547	\$605,830	\$1,100,752	\$200,454	\$4,906,325
05-Sep	\$649,157	\$1,268,326	\$980,587	\$512,842	\$1,360,995	\$102,959	\$4,874,868
12-Sep	\$936,200	\$1,304,884	\$804,124	\$662,549	\$1,309,042	\$52,863	\$5,069,662
19-Sep	\$296,120	\$1,083,055	\$401,661	\$388,775	\$735,452	\$128,890	\$3,033,953
26-Sep	\$73,445	\$218,684	\$46,358	\$36,995	\$94,715	\$17,735	\$487,932
<b>Total</b>	<b>\$12,547,469</b> <b>(8.0%)</b>	<b>\$42,621,263</b> <b>(27.2%)</b>	<b>\$32,882,883</b> <b>(21.0%)</b>	<b>\$22,562,843</b> <b>(14.4%)</b>	<b>\$38,170,050</b> <b>(24.3%)</b>	<b>\$8,135,146</b> <b>(5.2%)</b>	<b>\$156,919,654</b>

**Lime Complex**

20-Jun	\$357,190	\$1,357,148	\$971,344	\$1,019,159	\$1,855,724	\$313,241	\$5,873,806
27-Jun	\$744,472	\$2,151,838	\$1,319,217	\$2,005,590	\$2,657,150	\$497,055	\$9,375,321
04-Jul	\$894,586	\$2,307,834	\$947,291	\$1,896,543	\$2,331,134	\$412,157	\$8,789,544
11-Jul	\$762,966	\$2,022,958	\$964,288	\$1,895,120	\$2,040,431	\$310,762	\$7,996,524
18-Jul	\$792,417	\$2,324,760	\$1,429,151	\$2,149,788	\$2,397,250	\$492,686	\$9,586,051
25-Jul	\$1,259,851	\$2,191,872	\$1,848,708	\$2,216,712	\$2,834,931	\$910,170	\$11,262,244
01-Aug	\$628,425	\$1,997,504	\$1,359,146	\$1,760,263	\$2,076,917	\$473,808	\$8,296,063
08-Aug	\$366,071	\$1,572,531	\$650,139	\$1,240,491	\$1,205,416	\$163,674	\$5,198,322
15-Aug	\$127,105	\$1,471,689	\$487,643	\$650,785	\$848,815	\$237,366	\$3,823,403
22-Aug	\$78,175	\$1,056,912	\$178,465	\$537,905	\$401,483	\$172,460	\$2,425,399
29-Aug	\$50,424	\$321,559	\$11,454	\$300,912	\$120,951	\$71,774	\$877,074
05-Sep	\$18,683	\$120,573	\$7,000	\$290,623	\$96,334	\$21,840	\$555,052
12-Sep	\$13,329	\$101,407	\$73,850	\$321,733	\$161,064	\$60,986	\$732,370
19-Sep	\$0	\$90,111	\$77,742	\$207,794	\$75,022	\$70,771	\$521,440
26-Sep	\$0	\$38,891	\$15,020	\$115,564	\$15,025	\$31,871	\$216,372
03-Oct	\$0	\$12,705	\$0	\$82,026	\$0	\$0	\$94,731
10-Oct	\$0	\$5,075	\$0	\$39,604	\$0	\$0	\$44,679
17-Oct	\$0	\$494	\$0	\$27,901	\$0	\$0	\$28,395
24-Oct	\$0	\$2,048	\$0	\$21,217	\$0	\$0	\$23,265
31-Oct	\$0	\$1,397	\$0	\$15,155	\$0	\$0	\$16,552
07-Nov	\$0	\$200	\$0	\$0	\$0	\$0	\$200
<b>Total</b>	<b>\$6,093,693</b> <b>(8.0%)</b>	<b>\$19,149,505</b> <b>(25.3%)</b>	<b>\$10,340,456</b> <b>(13.7%)</b>	<b>\$16,794,885</b> <b>(22.2%)</b>	<b>\$19,117,648</b> <b>(25.2%)</b>	<b>\$4,240,620</b> <b>(5.6%)</b>	<b>\$75,736,806</b>

**Lonesome Complex**

15-Aug	\$452,655	\$90,638	\$528,501	\$125,328	\$238,295	\$0	\$1,435,417
22-Aug	\$93,587	\$456,792	\$722,013	\$157,997	\$431,247	\$91,800	\$1,953,436

Date	Aircraft	Camp Support	Crews	Equipment	Personnel	Supplies	Total
29-Aug	\$48,420	\$95,065	\$244,441	\$43,921	\$113,191	\$93,550	\$638,587
05-Sep	\$172,270	\$288,395	\$525,024	\$34,993	\$469,027	\$86,425	\$1,576,134
12-Sep	\$729,492	\$1,021,150	\$1,300,469	\$223,935	\$1,227,051	\$64,172	\$4,566,269
19-Sep	\$672,814	\$1,590,893	\$2,443,692	\$659,304	\$2,136,550	\$118,635	\$7,621,887
26-Sep	\$964,867	\$1,185,281	\$1,184,524	\$476,431	\$1,377,872	\$176,280	\$5,365,255
03-Oct	\$126,431	\$432,999	\$146,456	\$35,696	\$323,118	\$78,720	\$1,143,420
<b>Total</b>	<b>\$3,260,536</b> (13.4%)	<b>\$5,161,213</b> (21.2%)	<b>\$7,095,120</b> (29.2%)	<b>\$1,757,604</b> (7.2%)	<b>\$6,316,351</b> (26.0%)	<b>\$709,582</b> (2.9%)	<b>\$24,300,405</b>
<b>Piute</b>							
28-Jun	\$2,886,698	\$1,340,729	\$1,072,372	\$2,648,568	\$1,524,177	\$0	\$9,472,545
05-Jul	\$2,225,803	\$2,254,416	\$1,798,154	\$4,620,850	\$2,368,859	\$0	\$13,268,081
12-Jul	\$424,638	\$2,015,901	\$1,211,944	\$1,814,729	\$1,442,186	\$0	\$6,909,398
19-Jul	\$61,380	\$27,850	\$40,810	\$32,377	\$72,435	\$0	\$234,852
<b>Total</b>	<b>\$5,598,519</b> (18.7%)	<b>\$5,638,896</b> (18.9%)	<b>\$4,123,280</b> (13.8%)	<b>\$9,116,524</b> (30.5%)	<b>\$5,407,656</b> (18.1%)	<b>\$0,000</b> (0.0%)	<b>\$29,884,876</b>
<b>Rattle</b>							
23-Aug	\$0	\$2,880	\$0	\$0	\$0	\$0	\$2,880
30-Aug	\$187,206	\$62,536	\$66,619	\$15,010	\$147,380	\$15,000	\$493,750
06-Sep	\$1,424,184	\$1,233,623	\$1,381,043	\$853,296	\$1,957,972	\$221,950	\$7,072,069
13-Sep	\$1,494,418	\$1,470,509	\$1,920,759	\$1,200,920	\$2,325,489	\$343,500	\$8,755,596
20-Sep	\$376,331	\$1,531,058	\$1,451,648	\$1,062,226	\$1,912,503	\$316,050	\$6,649,815
27-Sep	\$316,588	\$929,081	\$528,440	\$461,904	\$679,007	\$85,975	\$3,000,995
04-Oct	\$27,718	\$327,614	\$126,888	\$90,278	\$107,401	\$15,325	\$695,225
<b>Total</b>	<b>\$3,826,445</b> (14.3%)	<b>\$5,557,302</b> (20.8%)	<b>\$5,475,397</b> (20.5%)	<b>\$3,683,634</b> (13.8%)	<b>\$7,129,751</b> (26.7%)	<b>\$997,800</b> (3.7%)	<b>\$26,670,329</b>
<b>Rich</b>							
29-Jul	\$1,620,099	\$2,039,622	\$1,314,368	\$1,496,394	\$1,814,992	\$232,113	\$8,517,588
05-Aug	\$210,879	\$1,627,435	\$1,083,583	\$1,724,967	\$1,665,903	\$382,094	\$6,694,861
12-Aug	\$19,502	\$768,869	\$326,229	\$561,504	\$501,251	\$83,410	\$2,260,767
19-Aug	\$0	\$25,291	\$206,164	\$212,862	\$201,258	\$0	\$645,573
26-Aug	\$0	\$37,455	\$203,471	\$215,429	\$152,748	\$0	\$609,103
02-Sep	\$0	\$20,418	\$150,712	\$148,965	\$125,230	\$0	\$445,325
09-Sep	\$0	\$16,282	\$79,221	\$123,267	\$94,640	\$0	\$313,410
16-Sep	\$0	\$14,576	\$79,221	\$106,394	\$94,640	\$0	\$294,831
23-Sep	\$0	\$5,424	\$33,952	\$40,320	\$40,560	\$0	\$120,256
<b>Total</b>	<b>\$1,850,481</b> (9.3%)	<b>\$4,555,371</b> (22.9%)	<b>\$3,476,923</b> (17.5%)	<b>\$4,630,101</b> (23.3%)	<b>\$4,691,222</b> (23.6%)	<b>\$697,618</b> (3.5%)	<b>\$19,901,715</b>
<b>Santiago</b>							
21-Oct	\$1,960,275	\$1,397,412	\$852,599	\$5,834,490	\$717,599	\$0	\$10,762,375
28-Oct	\$1,737,127	\$1,800,223	\$1,135,445	\$4,050,270	\$1,155,257	\$12,663	\$9,890,985

Date	Aircraft	Camp Support	Crews	Equipment	Personnel	Supplies	Total
04-Nov	\$273,306	\$967,789	\$521,223	\$890,225	\$600,218	\$778	\$3,253,540
<b>Total</b>	<b>\$3,970,707</b> (16.6%)	<b>\$4,165,425</b> (17.4%)	<b>\$2,509,268</b> (10.5%)	<b>\$10,774,985</b> (45.1%)	<b>\$2,473,074</b> (10.3%)	<b>\$13,441</b> (0.1%)	<b>\$23,906,900</b>
<b>Soda Complex</b>							
21-Jun	\$417,499	\$322,579	\$590,153	\$380,756	\$725,611	\$68,160	\$2,504,758
28-Jun	\$276,328	\$854,959	\$872,016	\$528,180	\$640,152	\$165,060	\$3,336,694
05-Jul	\$288,487	\$753,225	\$679,194	\$300,271	\$458,325	\$141,660	\$2,621,162
12-Jul	\$921,690	\$1,058,278	\$1,036,092	\$482,241	\$994,274	\$126,000	\$4,618,574
19-Jul	\$1,155,057	\$1,341,389	\$1,690,340	\$677,364	\$1,732,768	\$120,000	\$6,716,917
26-Jul	\$106,902	\$408,725	\$374,139	\$234,844	\$490,871	\$18,000	\$1,633,481
02-Aug	\$73,836	\$25,696	\$0	\$41,210	\$84,429	\$0	\$225,171
09-Aug	\$39,000	\$7,999	\$0	\$16,630	\$39,525	\$0	\$103,154
<b>Total</b>	<b>\$3,278,799</b> (15.1%)	<b>\$4,772,850</b> (21.9%)	<b>\$5,241,934</b> (24.1%)	<b>\$2,661,494</b> (12.2%)	<b>\$5,165,956</b> (23.7%)	<b>\$638,880</b> (2.9%)	<b>\$21,759,912</b>
<b>Yolla Bolly Complex</b>							
27-Jun	\$166,064	\$239,414	\$20,030	\$18,418	\$470,576	\$33,161	\$947,663
04-Jul	\$238,754	\$300,673	\$222,191	\$0	\$622,028	\$71,280	\$1,454,926
11-Jul	\$0	\$74,602	\$191,777	\$0	\$319,418	\$30,000	\$615,797
18-Jul	\$5,338	\$211,575	\$119,830	\$13,608	\$298,173	\$27,540	\$676,064
25-Jul	\$1,180,603	\$1,233,590	\$657,560	\$624,054	\$1,339,761	\$103,185	\$5,138,751
01-Aug	\$1,182,478	\$1,270,676	\$755,174	\$747,015	\$1,430,380	\$42,112	\$5,427,835
08-Aug	\$811,907	\$784,769	\$413,187	\$390,186	\$693,580	\$34,888	\$3,128,517
<b>Total</b>	<b>\$3,585,144</b> (20.6%)	<b>\$4,115,299</b> (23.7%)	<b>\$2,379,748</b> (13.7%)	<b>\$1,793,280</b> (10.3%)	<b>\$5,173,916</b> (29.8%)	<b>\$342,166</b> (2.0%)	<b>\$17,389,553</b>

Source: ECONorthwest, with data from I-Suite Database

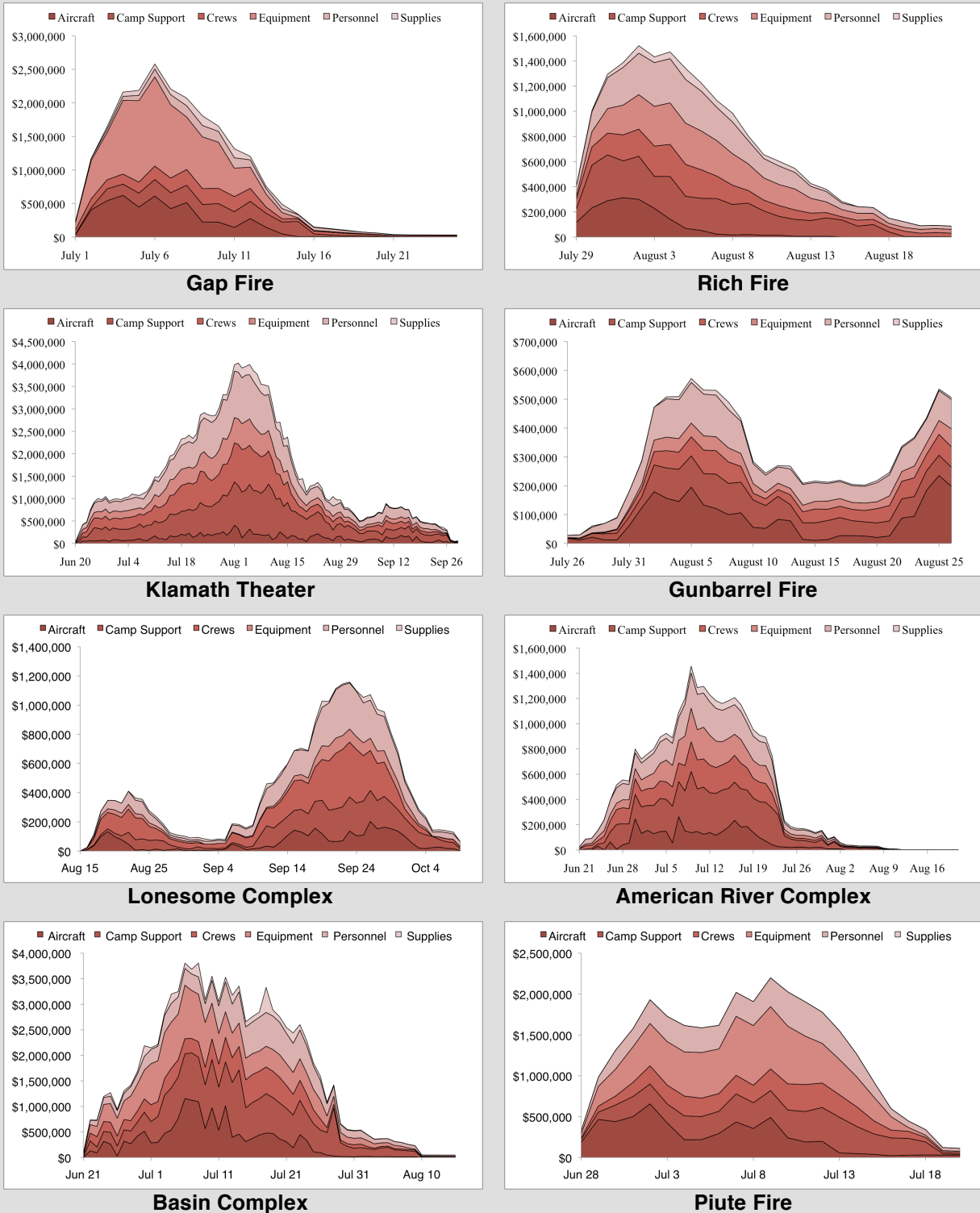
**Table A2. Summary of Fires by Complex, Teams, and Jurisdictions**

Fire Name	Type	Complex (Multiple Fires)	# of Type 1 Teams	# of Type 2 Teams	Multi-jurisdictional
Gap	Short	No	0	0	Yes
Piute	Short	No	0	0	Yes
Rich	Short	No	1	5	N/A
Santiago	Short	No	0 <sup>a</sup>	0 <sup>a</sup>	N/A <sup>a</sup>
American River Complex	Moderate	Yes	4	3	Yes
Basin Complex	Moderate	Yes	1	1	Yes
Chalk	Moderate	No	0	0	N/A
Cub Complex	Moderate	Yes	3	3	Yes
Hell's Half Complex	Moderate	Yes	0	1	Yes
Indians	Moderate	No	3	0	No
Slide	Moderate	No	0 <sup>a</sup>	0 <sup>a</sup>	N/A <sup>a</sup>
Soda Complex	Moderate	Yes	2	12	Yes
Trigo	Moderate	No	N/A	N/A	Yes
Bear Wallow Complex	Long	Yes	3	7	Yes
Blue 2	Long	No	0	4	Yes
Canyon Complex	Long	Yes	2	4	No
Gnarl Ridge	Long	No	N/A	N/A	Yes
Gunbarrel	Long	No	N/A	N/A	Yes
Iron & Alps Complex	Long	Yes	9	28	Yes
Lime Complex	Long	Yes	12	10	No
Lonesome Complex	Long	Yes	N/A	N/A	No
Panther	Long	No	2	4	Yes
Rattle	Long	No	N/A	N/A	No
Siskiyou Complex	Long	Yes	4	10	Yes
Ukonom-South Complex	Long	Yes	7	3	Yes
Yolla Bolly Complex	Long	Yes	7	6	Yes

Source: ECONorthwest, with data from InciWeb, The Incident Information System; "Federal Crew Assignment History," National Interagency Fire Center

Note: <sup>a</sup> Data not available for Slide and Santiago because the InciWeb data have expired for 2007 fires

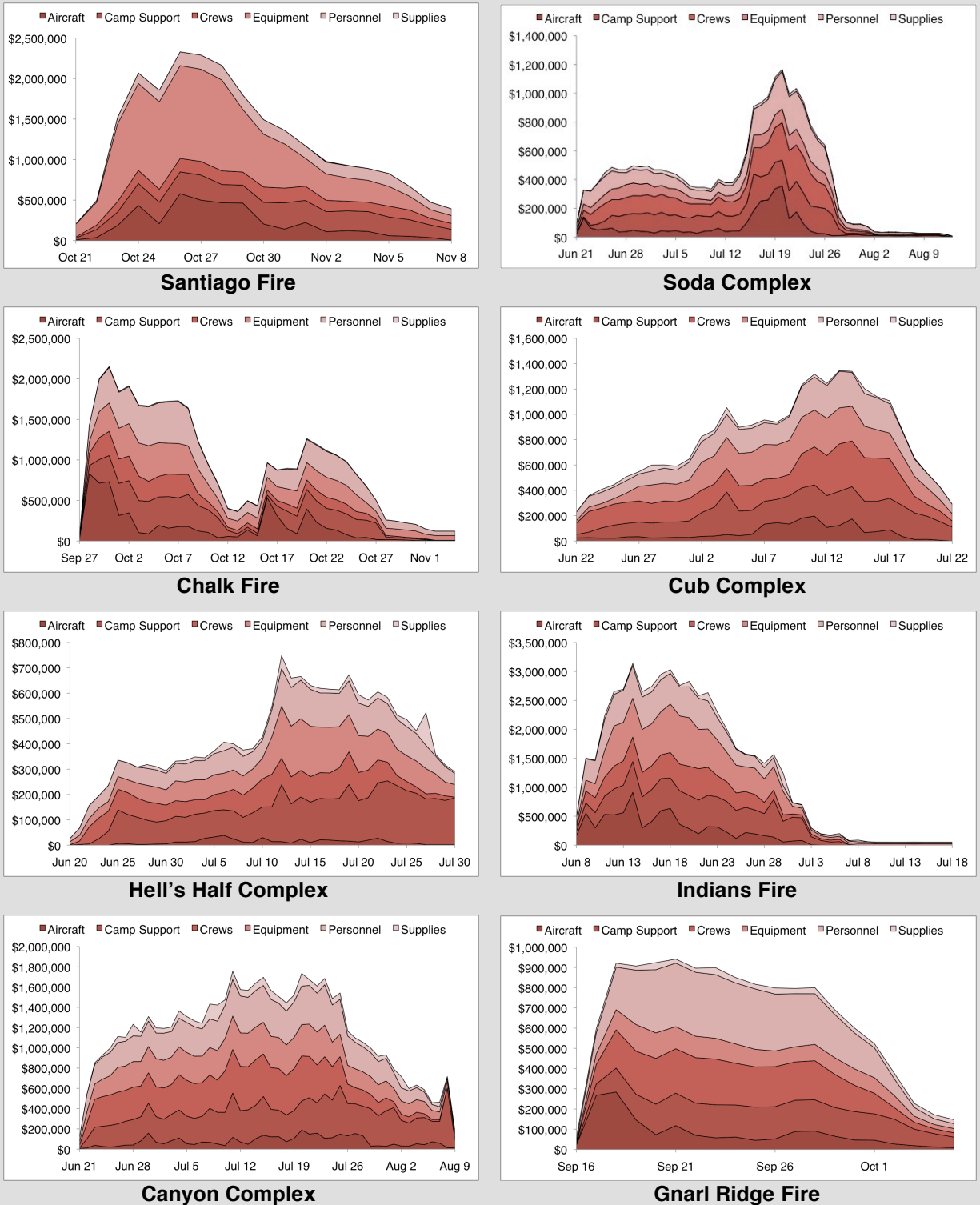
**Figure A3. Daily Disaggregated Costs by Incident**



Source: ECONorthwest, with data from I-Suite Database

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.

**Figure A3 (cont.). Daily Disaggregated Costs by Incident**

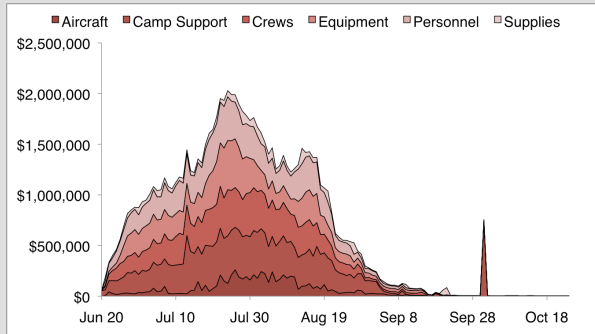


Source: ECONorthwest, with data from I-Suite Database

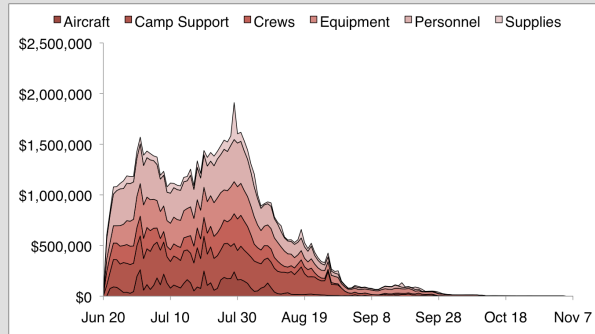
Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.



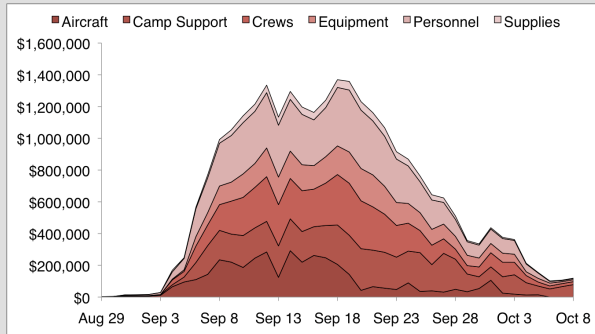
**Figure A3 (cont.). Daily Disaggregated Costs by Incident**



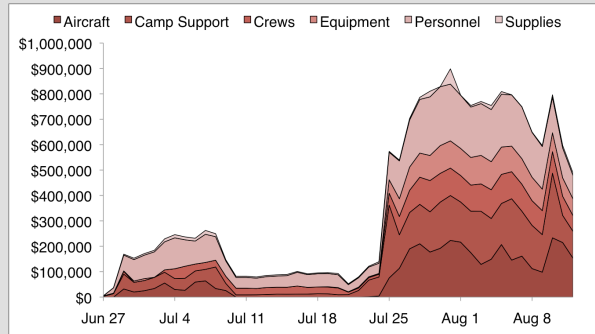
**Iron & Alps Complex**



**Lime Complex**



**Rattle Fire**

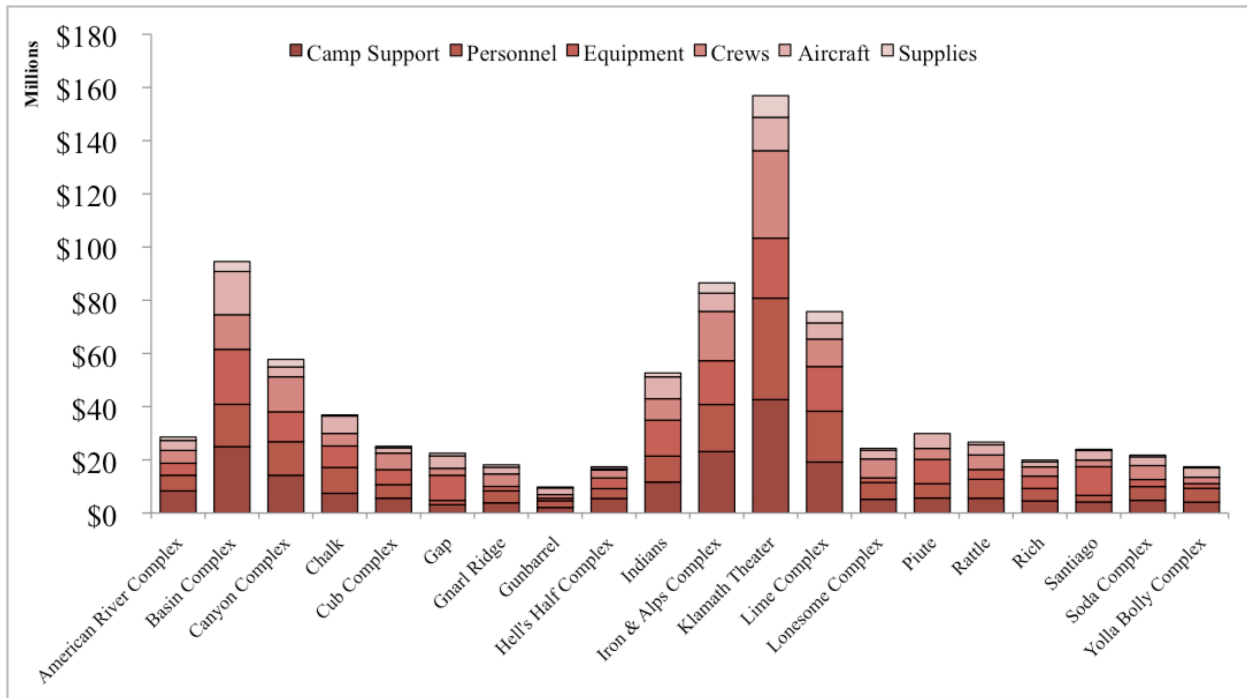


**Yolla Bolly Complex**

Source: ECONorthwest, with data from I-Suite Database

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.

**Figure A4. Suppression Costs by Category for Fiscal Year 2008 Large Wildfires**



Source: ECONorthwest, with data from I-Suite Database

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.

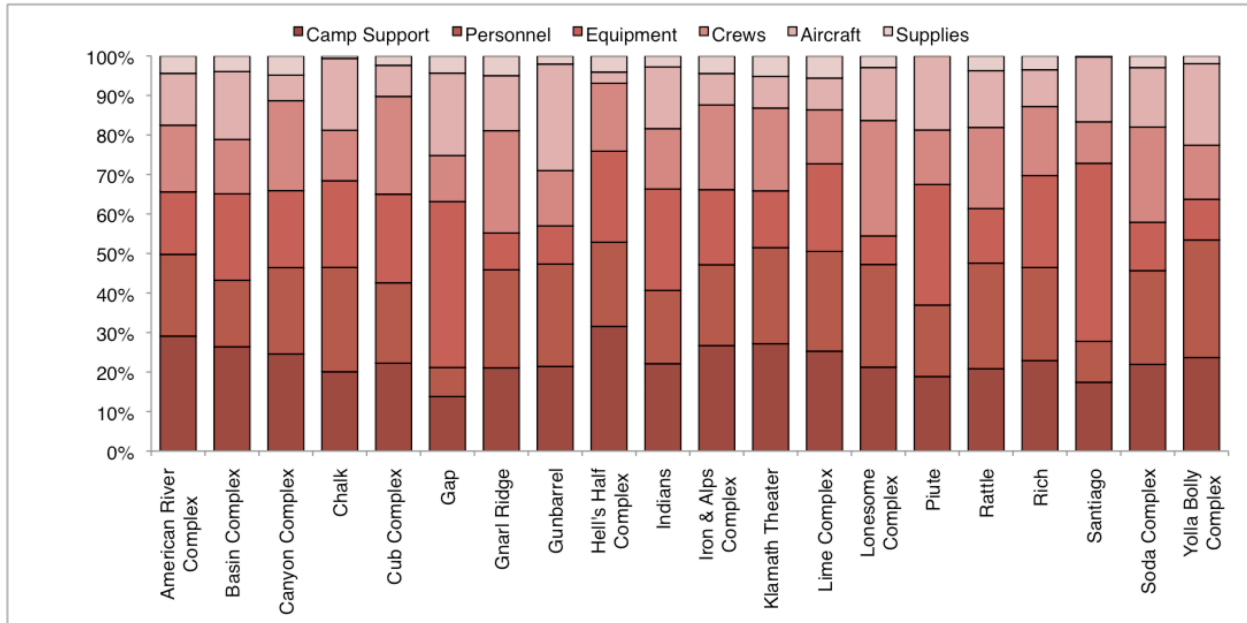
**Table A3. Disaggregated Costs of Each Incident Estimated by I-Suite Data**

<b>Fire Name</b>	<b>Aircraft</b>	<b>Camp Support</b>	<b>Crews</b>	<b>Equipment</b>	<b>Personnel</b>	<b>Supplies</b>	<b>Total</b>
American River Complex	\$3,749,702	\$8,310,952	\$4,819,603	\$4,510,618	\$5,908,253	\$1,256,760	\$28,555,889
Basin Complex	\$16,257,471	\$24,964,369	\$13,010,455	\$20,682,182	\$15,908,550	\$3,735,816	\$94,558,843
Canyon Complex	\$3,734,490	\$14,190,538	\$13,146,446	\$11,250,670	\$12,630,912	\$2,809,958	\$57,763,014
Chalk	\$6,697,512	\$7,403,566	\$4,712,375	\$8,086,560	\$9,734,780	\$232,000	\$36,866,794
Cub Complex	\$1,976,830	\$5,583,174	\$6,210,240	\$5,629,667	\$5,107,189	\$593,917	\$25,101,017
Gap	\$4,691,189	\$3,101,615	\$2,621,574	\$9,440,952	\$1,657,799	\$977,677	\$22,490,806
Gnarl Ridge	\$2,527,059	\$3,818,136	\$4,696,083	\$1,688,657	\$4,500,954	\$904,009	\$18,134,898
Gunbarrel	\$2,634,108	\$2,092,459	\$1,366,881	\$943,749	\$2,532,806	\$200,589	\$9,770,591
Hell's Half Complex	\$492,440	\$5,479,199	\$2,986,525	\$4,002,851	\$3,702,147	\$709,097	\$17,372,259
Indians	\$8,218,728	\$11,654,112	\$8,048,355	\$13,512,004	\$9,765,352	\$1,467,984	\$52,666,535
Iron & Alps Complex	\$6,888,498	\$23,100,044	\$18,551,090	\$16,441,913	\$17,714,189	\$3,839,015	\$86,534,749
Klamath Theater	\$12,547,469	\$42,621,263	\$32,882,883	\$22,562,843	\$38,170,050	\$8,135,146	\$156,919,654
Lime Complex	\$6,093,693	\$19,149,505	\$10,340,456	\$16,794,885	\$19,117,648	\$4,240,620	\$75,736,806
Lonesome Complex	\$3,260,536	\$5,161,213	\$7,095,120	\$1,757,604	\$6,316,351	\$709,582	\$24,300,405
Piute	\$5,598,519	\$5,638,896	\$4,123,280	\$9,116,524	\$5,407,656	\$0	\$29,884,876
Rattle	\$3,826,445	\$5,557,302	\$5,475,397	\$3,683,634	\$7,129,751	\$997,800	\$26,670,329
Rich	\$1,850,481	\$4,555,371	\$3,476,923	\$4,630,101	\$4,691,222	\$697,618	\$19,901,715
Santiago	\$3,970,707	\$4,165,425	\$2,509,268	\$10,774,985	\$2,473,074	\$13,441	\$23,906,900
Soda Complex	\$3,278,799	\$4,772,850	\$5,241,934	\$2,661,494	\$5,165,956	\$638,880	\$21,759,912
Yolla Bolly Complex	\$3,585,144	\$4,115,299	\$2,379,748	\$1,793,280	\$5,173,916	\$342,166	\$17,389,553

Source: ECONorthwest, with data from I-Suite Database

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.

**Figure A5. Shares by Cost Category, Fiscal Year 2008 Large Wildfires**



Source: ECONorthwest, with data from I-Suite Database

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.

**Table A4. Disaggregated Costs of Each Incident, by Percent**

Fire Name	Aircraft	Camp Support	Crews	Equipment	Personnel	Supplies
American River Complex	13.1%	29.1%	16.9%	15.8%	20.7%	4.4%
Basin Complex	17.2%	26.4%	13.8%	21.9%	16.8%	4.0%
Canyon Complex	6.5%	24.6%	22.8%	19.5%	21.9%	4.9%
Chalk	18.2%	20.1%	12.8%	21.9%	26.4%	0.6%
Cub Complex	7.9%	22.2%	24.7%	22.4%	20.3%	2.4%
Gap	20.9%	13.8%	11.7%	42.0%	7.4%	4.3%
Gnarl Ridge	13.9%	21.1%	25.9%	9.3%	24.8%	5.0%
Gunbarrel	27.0%	21.4%	14.0%	9.7%	25.9%	2.1%
Hell's Half Complex	2.8%	31.5%	17.2%	23.0%	21.3%	4.1%
Indians	15.6%	22.1%	15.3%	25.7%	18.5%	2.8%
Iron & Alps Complex	8.0%	26.7%	21.4%	19.0%	20.5%	4.4%
Klamath Theater	8.0%	27.2%	21.0%	14.4%	24.3%	5.2%
Lime Complex	8.0%	25.3%	13.7%	22.2%	25.2%	5.6%
Lonesome Complex	13.4%	21.2%	29.2%	7.2%	26.0%	2.9%
Piute	18.7%	18.9%	13.8%	30.5%	18.1%	0.0%
Rattle	14.3%	20.8%	20.5%	13.8%	26.7%	3.7%
Rich	9.3%	22.9%	17.5%	23.3%	23.6%	3.5%
Santiago	16.6%	17.4%	10.5%	45.1%	10.3%	0.1%
Soda Complex	15.1%	21.9%	24.1%	12.2%	23.7%	2.9%
Yolla Bolly Complex	20.6%	23.7%	13.7%	10.3%	29.8%	2.0%

Source: ECONorthwest, with data from I-Suite Database

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.

**Table A5. Total Cost Comparison by I-Suites Estimate, Actual Cost, and 209 Estimate**

Fire	I-Suites Incident Total Cost	Actual Total Cost by P-Code	209 Estimated Total Cost	Ratio of I-Suites Estimate to Actual Cost	Ratio of I-Suites Estimate to 209 Estimate	Ratio of 209 Estimate to Actual Cost
American River Complex	\$28,555,889	\$20,434,548	\$23,950,980	139.7%	119.2%	117.2%
Basin Complex	\$94,558,843	\$26,053,922	\$78,096,079	362.9% <sup>a</sup>	121.1%	299.7%
Canyon Complex	\$57,763,014	\$40,714,811	\$45,501,474	141.9%	126.9%	111.8%
Chalk	\$36,866,794	\$24,101,280	\$24,042,000	153.0%	153.3%	99.8%
Cub Complex	\$25,101,017	\$18,362,345	\$21,000,000	136.7%	119.5%	114.4%
Gap	\$22,490,806	\$13,452,097	\$20,970,000	167.2%	107.3%	155.9%
Gnarl Ridge	\$18,134,898	\$11,827,146	\$15,611,533	153.3%	116.2%	132.0%
Gunbarrel	\$9,770,591	\$9,015,294	\$11,200,000	108.4%	87.2%	124.2%
Hell's Half Complex	\$17,372,259	\$13,581,179	\$14,135,834	127.9%	122.9%	104.1%
Indians	\$52,666,535	\$40,715,845	\$42,500,000	129.4%	123.9%	104.4%
Iron & Alps Complex	\$86,534,749	\$64,671,381	\$73,974,917	133.8%	117.0%	114.4%
Klamath Theater	\$156,919,654	\$109,531,553	\$126,086,065	143.3%	124.5%	115.1%
Lime Complex	\$75,736,806	\$51,630,344	\$59,329,698	146.7%	127.7%	114.9%
Lonesome Complex	\$24,300,405	\$14,512,841	\$18,411,841	167.4%	132.0%	126.9%
Piute	\$29,884,876	\$15,963,158	\$25,000,000	187.2%	119.5%	156.6%
Rattle	\$26,670,329	\$17,353,547	\$21,057,784	153.7%	126.7%	121.3%
Rich	\$19,901,715	\$10,900,065	\$15,000,000	182.6%	132.7%	137.6%
Santiago	\$23,906,900	\$9,589,035	\$21,650,000	249.3% <sup>a</sup>	110.4%	225.8%
Slide	N/A	\$23,441,224	\$27,147,745	N/A	N/A	115.8%
Soda Complex	\$21,759,912	\$14,562,964	\$17,538,075	149.4%	124.1%	120.4%
Trigo	N/A	\$8,588,060	\$10,974,296	N/A	N/A	127.8%
Yolla Bolly Complex	\$17,389,553	\$13,378,402	\$16,100,000	130.0%	108.0%	120.3%

Source: ECONorthwest, with data from I-Suite database, Albuquerque Service Center TROB Detail Reports, ICS-209s

Note: I-Suite data are estimates from the field. I-Suite data can occasionally contain anomalies, which most likely can be attributed to mis-estimation or mis-entry in the field. The original list of 26 incidents is reduced to 20 here as Siskiyou Complex, Blue 2, Panther, Bear Wallow Complex, and Ukonom-South Complex are consolidated into Klamath Theater, and the I-Suite data for the Trigo and Slide are not reliable.

**Table A6. Actual Versus Stratified Cost Index Predicted Costs/Acre for Fiscal Year 2008 Fires Exceeding \$10 Million in Total Expenditures**

Fire Name	Region	Total Acres	Actual FS Expenditures	Actual Cost/Acre	Expected Cost/Acre	Difference Measured in STDs from the Expected Value
Basin Complex	5	162,818	\$68,612,197	\$421	\$64	1.56
Indians	5	81,378	\$40,812,649	\$502	\$272	0.55
Mill	5	65,834	\$30,037,639	\$456	\$342	0.32
Pit	5	11,496	\$26,603,200	\$2,314	\$580	1.09
Miners	5	24,776	\$25,871,324	\$1,044	\$421	0.45
Slide	5	12,759	\$24,677,698	\$1,934	\$741	0.57
Chalk	5	11,200	\$23,282,361	\$2,079	\$73	2.18
Blue 2	5	17,540	\$21,832,840	\$1,245	\$352	0.30
Eagle	5	32,059	\$20,002,772	\$624	\$423	0.51
Buckhorn	5	31,419	\$17,793,488	\$566	\$233	0.26
Rattle	6	19,775	\$17,647,746	\$892	\$282	0.12
Iron	5	32,903	\$16,691,177	\$507	\$237	0.44
Piute	5	37,026	\$16,082,555	\$434	\$217	0.33
Gap	5	9,443	\$16,076,894	\$1,703	\$335	1.48
Cedar	5	25,398	\$15,815,756	\$623	\$377	0.20
Panther	5	24,768	\$15,327,761	\$619	\$74	1.52
Caribou	5	13,116	\$14,362,710	\$1,095	\$16	3.06
Cub	5	14,936	\$14,127,038	\$946	\$236	1.29
Middle Fork	6	21,125	\$13,916,066	\$659	\$156	1.05
Half	5	15,118	\$13,644,836	\$903	\$230	0.28
Jake	5	38,394	\$13,609,095	\$354	\$64	1.18
Cold	5	5,512	\$13,497,286	\$2,449	\$1,175	0.55
Gnarl Ridge	6	3,280	\$12,235,615	\$3,730	\$1,320	0.12
Rich	5	6,112	\$10,907,891	\$1,785	\$1,116	0.48
Westville	5	10,836	\$10,875,212	\$1,004	\$697	0.28

Source: Rocky Mountain Research Station with data from U.S. Department of Agriculture, Forest Service, Washington Office

Note: This list of fires does not correspond directly to the main list of 2008 large wildfires because this list disaggregates some of the theater and complex fires



## ATTACHMENT 2: META-ANALYSIS AND SELECTED VALIDATION OF REGIONAL REVIEWS<sup>1</sup>

### Summary of Findings

We find that the Forest Service exercised fiscal diligence in the management of costs for large wildfire incidents (those exceeding \$10 million) during fiscal year 2008. This finding results from a meta-analysis of selected regional large fire cost reviews and is validated by analysis of pertinent documents, databases and interviews. While fiscal diligence was exercised, there is nevertheless potential to reduce fire management costs.

### Meta-Analysis

We performed a meta-analysis of Forest Service regional large fire cost reviews to arrive at the fiscal diligence finding. We believe that analysis of these cost reviews (selectively validated by interviews and examination of a sample of fire cost documents and databases) provides adequate information concerning the primary cost elements.

The regional reviews are based on specific standards, principles, and guidance contained in the Forest Service May 2007 *Regional Large Fire Cost Review Guidebook*. These standards are based on “Generally Accepted Government Auditing Standards” (GAGAS) for performance audits. If they are followed during the regional reviews, these standards should provide valid and consistent results across regions. According to the *Guidebook*, each region prepares one report reviewing all of the fires that exceeded a \$5 million cost threshold. Each report includes

- An executive summary of report highlights.
- A summary of each fire reviewed that includes the initiation date, full containment date, significant weather or other events that affected fire suppression, whether or not a cost share was in place, the type of cost share agreement, and, if possible, an estimate of how much each entity will pay. Other items of interest include the peak number of personnel on the fire and a cost breakdown by major cost component, e.g., personnel, supplies, aircraft, equipment, crews, and camp support.
- An expenditure analysis that includes tactical and strategic decisions and related costs; specific costs incurred by review teams while on the fire; and where possible, quantification of costs as they relate to tactical and strategic decisions made across fires. Recommendations are to be tied directly to the costs identified.

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<sup>1</sup> This attachment was written by Sharon L. Caudle.

- Findings, which include criteria, condition, cause, and effect of the fire or fires; the primary sub-objectives for the review; and whether there was sufficient and reliable information about social factors, risk management, and tactical decisions. The *Guidebook* provides specific questions to be answered when addressing the primary sub-objectives.
- Recommendations that follow as a logical consequence of the review findings. Where similar findings and recommendations arise across fires, they are to be consolidated.

The *Guidebook* provides a sample report to guide the 2008 fire teams.

The primary objective of each review, according to the *Guidebook*, is to “determine if resources including funds, equipment and people were used appropriately to identify areas for more effective and efficient future wildfire suppression” (p. 11). Specific areas for review include (1) sufficient and reliable information, (2) socio-political factors, and (3) risk management, and tactical decisions. These review areas and the required report coverage are more fully explained in Table 1, drawn from the *Guidebook* requirements.

According to the *Guidebook*, each region is to review at least eight fires over \$5 million and no less than 75 percent of the total fires with costs over \$5 million. The number of reviews can be adjusted if there are extraordinary circumstances creating a hardship for regional review completion. Using a meta-analysis approach,<sup>2</sup> the Panel analyzed regional reviews that had at least one fire with over \$10 million in costs for its determination of fiscal diligence. While the regional findings and recommendations generally are not limited to fires exceeding \$10 million in costs, the threshold for Panel review, we believe the findings and recommendations are sufficiently valid in applying to fires over \$10 million in costs. Table 2 describes the completed fiscal year 2008 large-fire cost reviews that we analyzed, and fires in each review with costs over \$10 million.<sup>3</sup>

The regional reviews are sufficiently comprehensive in discussing findings for a meta-analysis of these to be useful. Interviews and an examination of a sample of fire cost documents and databases validated the general findings of the regional reviews and did not surface any lack of fiscal diligence. The regional findings and recommendations are detailed and discussed in Attachment 3, regarding review requirements and usefulness in general.

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<sup>2</sup> Meta-analysis is a technique for collecting and reviewing previous research, such as the regional large fire cost reviews, through a process of summarizing and integrating the research findings, and then analyzing those findings to determine overall trends and impacts.

<sup>3</sup> The Panel also reviewed the reports of the Northern Region and Intermountain Region, whose fire costs did not exceed \$10 million. These and the other regional reports will be discussed in more detail in Attachment 3.

**Table 1. May 2007 Regional Large Fire Cost Review Guidebook**

<b>Element</b>	<b>Assessment Coverage</b>
Sufficient and Reliable Information	Access of line officers and incident commanders to necessary and sufficient reliable information to best manage the fire
	Linkage of the LMP and FMP and their direction to inform wildfire suppression strategies
	Sufficiency of delegation of authorities in guiding protection and cost containment
Social Factors	Identification of social and political factors driving fire costs
	Satisfaction of social and political factors and to what extent
	Cost impact of mitigating social and/or political factors
Risk Management	Identification of fire threats to specific values
	Decision process that balances threats to values with the acceptability of costs
	Risk sharing with the general public and local, state, and federal agencies
	Decision improvements or changes to help decisions on future fires
Tactical Decisions	IMT and ACC actions to control costs on their own
	Direction from others for IMT and ACC action to control costs
	Impact of resource availability, capability, or efficiency on tactical decisions, size, and/or final fire cost
	Impact of AA direction on overall fire costs

Source: Regional Large Fire Cost Review Guidebook

**Table 2. Regional Reports Analyzed and Fires Over \$10 Million in Costs**

Regional Review Report	Fires Over \$10 Million in Costs
Rocky Mountain Region (R2) October 31, 2008	Gunbarrel Fire
Southwestern Region (R3) Undated	Trigo Fire
Pacific Southwest Region (R5) February 12, 2009	Klamath Theatre (Siskiyou Complex, Panther, Bear Wallow Complex, Ukonom Complex, Siskiyou, Blue 2)  Basin Complex  Iron-Alps Complexes  Lime Complex  Indians Fire  Slide Fire  American River Complex  Cub Complex  Piute Fire  Soda Complex (Big, Black, Monkey Rock, Mill)  Rich Fire  Gnarl Ridge Fire  Lonesome Complex  Rattle Fire

Source: Large-Cost Fire Independent Review Panel

## **ATTACHMENT 3: THE LINE OF SIGHT: RECOMMENDATIONS TO ACTION TO MEASURES TO ACCOUNTABILITY<sup>1</sup>**

Over the past decade, the Forest Service and other federal land management agencies have received numerous recommendations targeting wildland fire costs. It is apparent from the background material we reviewed that significant positive change in the conditions and causes impacting wildfire costs has been elusive. The internal and external reviews, from independent panels to the Quadrennial Fire Reviews, have essentially described similar causes and conditions and recommendations for action. The most recent strategic plan and budget justification for the Forest Service reflects awareness of a number of these causes and conditions, but it is also evident that means and strategies over the past many years tell a story of limited progress. This suggests to us that either the recommendations are not valid, cannot be feasibly implemented, or that the Forest Service and other federal land management agencies need to refresh their approach in managing implementation of the recommendations and their operational results.

We believe that the vast majority of recommendations from these reviews remain appropriate, particularly in tackling underlying conditions and causes that impact costs before and during a fire season. We believe that action should be taken to strengthen the current Forest Service management decision process and create a line of sight, from conditions and causes, to action, to performance, to assessment. Performance measures should directly reflect prevention and/or mitigation of causes. The 2009 QFR and the Ten Year Comprehensive Strategy and the Strategy's latest implementation plan might serve as foundational documents in this effort, including better targeting of performance measures for wildland fire results management. Performance measures should directly reflect mitigation of causes, and emphasize outcomes over output and process measures. Such an approach should strengthen the current operating standards used by the Forest Service for work planning and accomplishment reporting and follow-on work programs and individual projects.

In addition, we believe that the current framework for wildland fire cost and management reviews should be replaced with a streamlined, rigorous, and targeted approach taking advantage of internal and external reviews. These reviews would assess strategic and operational actions continuously before, during, and after a fire season and within individual fires and facilitate immediate or longer-term decision-making. Pre-fire season reviews might assess the magnitude of impact to be expected from actions such as, the work of NIMO teams in planning and exercises with partners, or in reducing hazardous fuels in priority areas. During the fire season, reviews should be ones of engagement as conditions are scrutinized, alternative strategies considered, and the most appropriate strategy selected. A lesser priority might be reviews after a fire or

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<sup>1</sup> This attachment was written by Sharon L. Caudle.

fire season, simply because the context of decision-making often is lost or re-interpreted, such as the bigger picture of constrained resources and economic, political, and social conditions. Reviews after a fire or fire season should not attempt to deconstruct decisions or costs, but instead identify better practices impacting management and firefighting investments that might be applied during the next fire event or season. Finally, the findings and recommendations in these reviews should result in the development of specific actions, and progress towards implementing actions and recommendations should be provided to future independent review panels.

This attachment, supported by appendices, identifies that review findings and policies frequently do not resolve identified issues, and suggests approaches to strengthen existing management and review processes to facilitate and strengthen desired organizational outcomes. We analyze past review findings and past and current policies and present observations. We identify an actionable planning framework for implementing strategy. Lastly, we present a model for scoping future reviews.

## **Findings and Observations Leading to an Actionable Policy and Planning Framework**

There have been a number of internal and external reviews on wildland fire management and costs. These have included past independent review panels and regional reviews. The following describes the independent review panel work over the past several years and the most recent regional reviews for the fiscal year 2008 fires.

### **Independent Panel Reviews**

Past independent review panels have provided a strong set of conditions, causes, and recommendations. Table 1 provides a summary from those part reports, including the 2007 and 2008 Brookings reports and the 2005 and 2006 Ferraro reports. The full details are in Appendix A. The 2007 and 2008 reports appear the most reflective of the current fire environment and a strategic approach to fire management. The past panel reports have progressed over time from reviewing and commenting on more operational issues to more strategic fire management decision-making.

The National Academy of Public Administration (NAPA), the USDA Office of the Inspector General (OIG) and the Government Accountability Office (GAO) reports make similar recommendations. For example, NAPA in 2002 recommended action to control the accumulation of hazardous fuels. USDA OIG in 2006 recommended that suppression costs needed to be fairly shared by state and local governments and cost containment controls need to be strengthened. GAO in 2009, drawing on past work, recommended an agency-wide strategy for containing fire suppression costs.

**Table 1. Past Independent Panel Observations and Recommendations**

Topic	Condition/Cause	Recommendation (Desired State)
Land Management Plans (LMPs)	<p><i>Condition:</i> LMPs are often decades old and do not reflect changed ecosystem conditions.</p> <p><i>Cause:</i> The length of time it takes to develop an LMP may be eclipsing consideration of current fire effects. There are significant legal challenges and political obstacles that confront federal LMP revision efforts.</p>	Develop guidance for future revisions of LMPs to incorporate elements of the importance of fuels reduction activities, fire history, changes in the WUI, and how these elements impact land management.
Appropriate Management Response	<p><i>Condition:</i> The LMPs generally did not discuss AMR. AMR is not understandable to the public and neighboring partners. There is a lack of consistent definitions across the Forest Service regions and the five federal agencies.</p> <p><i>Cause:</i> See discussion on LMPs above.</p>	Continue expanding AMR guidance on FMPs to increase “transparency” on suppression tactics and alternatives, development of consistent definitions, clarification of fire operational strategies, and techniques for developing incident management strategies.
Fire Management Plans (FMP)	<p><i>Condition:</i> FMPS were often not current and, if updated, had minimal changes and did not address key component changes. There is a lack of sufficient detail and discussion of key elements for developing an effective fire management strategy or to share with neighboring communities and other jurisdictions.</p> <p><i>Cause:</i> FMPs are not seen as strategic documents in fire management; They are seen as a repository for policies, operational processes, communications information, and corresponding documents. Unresolved legal challenges also curb the desire to significantly revise an FMP.</p>	Transform FMPs from static, updated program reference documents to more strategic assessments of fire management planning and policies, and develop a more selective approach to FMP revision.
Federal and Non-Federal Jurisdictional Collaboration	<p><i>Condition:</i> Discussions among federal land managers and neighboring jurisdictions are generally limited to cost share agreements, protection boundaries, evacuation plans and occasional fuels treatment projects.</p> <p><i>Cause:</i> There is a lack of commitment by federal units to collaborate with communities in their FMP processes or to integrate community CWPP efforts with federal fire prevention and suppression planning.</p>	Create a stronger linkage from FMPs to CWPP by creating a more collaborative approach for fire prevention planning than exists now.
Fuels Treatment Backlog	<p><i>Condition:</i> Pre-incident fuel treatments are limited and dramatically below inventoried levels. Wildland fire use faces barriers as a fuel reduction strategy.</p> <p><i>Cause:</i> Limited budgets constrain fuel treatments. Wildland fire use is still a new concept. There is concern about the spread of wildland fire uses off of national lands.</p>	None explicitly stated.
Wildland Fire Situational Analysis and Decision Support Tools	<p><i>Conditions:</i> The Delegation of Authority letters did not provide realistic cost objectives or measures or establish suppression resource priorities to complex incidents. Complexes are not addressed at times in the WFSAs; WFSAs strategies and</p>	Encourage more collaboration in the WFSAs process. Address options for short term and long term management of suppression resources. Make delegation letters strategic documents to contain specific statements outlining larger suppression objectives,



Topic	Condition/Cause	Recommendation (Desired State)
	<p>trigger points are often at odds with other jurisdictional interests. Long Term Implementation Plans did not include cost containment strategies or cost behavior strategies.</p> <p><i>Cause:</i> Units generally had problems with use of, and confidence in, the decision support tools in assisting in formulating suppression strategies. There was no clear pattern for the preparation of a new WFSAs. WFSAs process was often treated by IMTs more as an obligatory document than a guiding strategic suppression tool. WFSAs did not have adequate senior line management oversight.</p>	<p>resource values and final restoration concerns, expectations about containing fire cost growth, and performance measures for successful suppression, cost management, and public and firefighter safety. Ensure that the next generation of decisional support processes learns from the WFSAs process.</p>
<p>Decision Space for Agency Administrators and IMTs</p>	<p><i>Condition:</i> There is little variance in the mix of resources deployed or expenditure rate for a type 1 or 2 IMT.</p> <p><i>Cause:</i> Wildfire expenses may be driven more by national and regional policies than any other factor. AAs and IMTs are assigned multiple protection objectives by regulations, policies, land management objectives, public expectations, and organizational guidelines. Layers of rigid constraints cause reduced decision space. There is a uniformity of suppression strategy.</p>	<p>Perform a resource optimization analysis for extended attack to compare the contribution of additional resources per unit of cost. Reconcile national, state, and regional contract standards.</p>
<p>Incident Management Team Structure, Staffing, Transitioning, and Resourcing</p>	<p><i>Conditions:</i> Assets are reassigned daily based on demand. IMT assignment limits do not reflect short fire or longer fire rotation needs and increase transitions. Transition to lower level IMTs are delayed due to lack of capacity.</p> <p><i>Cause:</i> National fire resources have national utilization, high demand, limited availability, and unique status-reporting requirements. IMTs are founded on consistency and reliability. What is made available for fire support is often determined more by supply than fire management need.</p>	<p>Tailor more agile IMTs to fit the needs of the incident and prolonged fire operations. Enhance local type 3 IMTs for incident closeout. Continue to pursue more flexible suppression strategies. Conduct rigorous needs analyses of the suppression role of national resources.</p>
<p>Collaborative Cost Management Strategy</p>	<p><i>Condition:</i> Achieving cost management is unclear. Large wildfire complete cost cycle is not understood. The IBA has a marginal impact on reducing fire suppression costs. Procurement and acquisition does not differentiate between a short and long term events.</p> <p><i>Cause:</i> There is a lack of individual cost tracking from fire origin to restoration work. The IBA ensures cost accountability and fiscal integrity. Pre-fire discussions neither narrow the cost differences between federal, state, and contractor costs and nor size the pool of resources in advance of reaching the highest preparedness levels.</p>	<p>Formulate a collaborative cost management strategy that provides a better picture of fire suppression costs over the incident span.</p>
<p>Off-Forest Values</p>	<p><i>Condition:</i> Every available resource, regardless of cost, is used to control a large</p>	<p>Provide standards and clarification to field units about how much effort should be expended to prevent wildland fires from</p>

Topic	Condition/Cause	Recommendation (Desired State)
	<p>fire and/or protect structures.</p> <p><i>Cause:</i> Suppression expenses escalate when private inholdings, other ownership lands, and infrastructure adjoin national forests. There is strong social and political pressure to protect off-forest values from the effects of wildfires on national forests. Forest Service direction did not address fiscal limitations for wildland fires that threaten other jurisdictions.</p>	<p>escaping onto other jurisdictions or. Provide clarification as to if, or how, suppression costs should be apportioned with threatened jurisdictions.</p>
Reviews, Reports, and Outcome Metrics	<p><i>Condition:</i> The utility and value of cost containment reviews appears limited.</p> <p><i>Cause:</i> Expense accountability was emphasized over suppression total cost-effectiveness. There is no national or regional standard of analysis and mechanism for disseminating information back to local managers. An integrated review approach and evaluative framework from individual fires to national strategies was not used.</p>	<p>Revise the thresholds and selection criteria for regional and national reviews and tier the evaluation objectives of reviews so that they are more strategically-based assessments of progress made towards desired outcomes. Re-evaluate the policy of conducting cost containment reviews.</p>
	<p><i>Condition:</i> Fire outcomes are measured in terms of cost per acre. There is no metric that balances the number of acres protected.</p> <p><i>Cause:</i> Fire outcomes with costs and benefits are not identified. There is no consideration as to whether a fire should have been suppressed in the first place.</p>	<p>Develop a better set of outcome metrics to capture the concept of investment and the complete cost cycle on large wildland fires.</p>
National Policies: Firefighter and Public Safety	<p><i>Condition:</i> Fires escaped initial attack or were not contained at smaller sizes.</p> <p><i>Cause:</i> There is an excessive focus on safety and low risk tolerance.</p>	<p>No direct recommendation. The panel noted a shift to a principle-based approach requiring situational judgment.</p>

## 2008 Regional Reviews

The 2008 regional reviews covered fires with costs over \$5 million. Recommendations generally referenced guidance and direction, and (to a lesser extent) topics such as leadership, collaboration, training, and decision tool evaluation. Appendix B provides regional recommendations for future strategic and tactical decision-making<sup>2</sup>. In some cases, regions made similar or related recommendations, but presented these recommendations in different review areas in the individual reports. Table 2 presents our synthesis of the findings, including those of the Intermountain and Northern Region fires costing less than \$10 million, categorized under the headings: policy and guidance improvements, policy and guidance compliance, pre-season planning and strategy development, post-season reviews and action, training and capability development, decision support tool improvements, fire incident overall strategy, and fire incident tactical and operational improvements.

<sup>2</sup> Appendix B is specific to recommendations for fires over \$10 million in costs.

We are concerned that the regional review recommendations covered a wide range of topics and levels of action that should have been mitigated or are insignificant in impacting costs. Recommendations targeted strategic issues such as national direction and policy and tactical concerns such as the use of cell phones and simple documentation needs. While we recognize that the majority of the findings might impact on overall fire costs, it was not clear what would be the magnitude of cost impacts if fully implemented. For example, following well-established policy direction and well-grounded decision processes should have an impact, but the reports did not clearly describe explicit “cause and effect” of implementing recommendations and specific cost savings or increases. In fact, we are concerned that so many recommendations covered areas such as simply following established policy or using available decision support tools. This indicates more systemic management and oversight concerns than simply focusing on cost issues. It also may indicate challenges in adequately crafting a review approach that would more rigorously identify risk factors and resulting cost implications.

**Table 2. Forest Service 2008 Regional Review Recommendations**

Coverage Area	Regional Recommendation
Policy and Guidance Improvements	<p>Explore the development and implementation of criteria and definitions regarding structure protection and perimeter control, including conditions under which firefighting efforts stop protecting wildlands and start protecting structures (R5)</p> <p>Develop clear, consistent national and regional direction on cost containment terminology and tool use, including the WFIP, WFSA, and SCI (R2)</p> <p>Develop fire management guidance that is consistent with the management goals for LSR, riparian reserves, and wilderness (R5)</p> <p>Provide written protocols for providing incident financial oversight and coordination between oversight personnel (R2)</p> <p>Provide explicit national direction regarding Forest Service protection of communities and structures on private lands and adjacent to the national forests when local and state agencies are unwilling or unable to do so (R5)</p> <p>Consolidate all fire management policy in the forest fire management plan (R3)</p> <p>Clarify trainee and mentoree approval, mobilization, confirmation, and accounting on federal fires (R2)</p> <p>Recommend the Washington Office provide access to the Key Decision Log to allow out-of-agency personnel access (R4)</p>
Policy and Guidance Compliance	<p>Do not deviate from law or policy governing financial management, including terms and conditions of existing agreements (R5)</p> <p>Follow objectives stated in the delegation of authority (R3)</p> <p>Ensure proper signatures, dates, and preparation of resource appendices in fire management plans and preparedness plans (R3)</p> <p>Follow agency policy and specific national forest fire management plans (R3)</p> <p>Document actions taken on incidents (R5)</p> <p>Ensure DOA objectives are clear, expectations are measurable, and procedures for modifying the prescribed course are described (R5)</p> <p>Update the fire management plan regarding night operations, clearly communicate this direction, and determine where conditions exist that could prohibit fire suppression night operations (R3)</p>

Coverage Area	Regional Recommendation
	<p>Formalize procedures for ordering IMTs and negotiating pre-team orders of personnel and other items with the incoming incident commander (R2)</p> <p>Continue to work with NRCG partner agencies to develop a geographic area wide wildfire response guide that includes all partners (R1)</p>
<p>Pre-Season Planning and Strategy Development</p>	<p>Update the fire preparedness plan and pre-season agreements annually before the start of the fire season (R3)</p> <p>Update state and federal DPAs to more accurately reflect individual agency responsibilities (R5)</p> <p>Continue work with adjacent landowners and tribes before each fire season begins and prior to emergency situations (R5)</p> <p>Have and document pre-season agreements prior to each year’s fire season and include them as appendices in the fire management plan (R3)</p> <p>Develop and maintain comprehensive data bases for the values-at-risk in each fire management unit and include those in pre-season updates in cost data files (R5)</p> <p>Emphasize community wildland fire protection and firewise communities in collaboration with state, county, landowner, tribal, and other federal cooperators (R3)</p> <p>Develop a statewide strategy of incentives for local and state governments to share in the cost of suppressing fires before they reach inhabited areas and for making inhabited areas less at risk from wildland fires (R5)</p> <p>Rewrite resource sharing agreements to be in compliance with the CFMA (R5)</p> <p>Continue to provide outstanding leadership in cost apportionment agreements (R1)</p>
<p>Post-Season Reviews and Action</p>	<p>Conduct a post-action review by forest, zone dispatch, and cooperators to discuss lessons learned (R3)</p>
<p>Training and Capability Development</p>	<p>Develop a training policy for the region (R3)</p> <p>Provide an in-depth evaluation of federal employee training process, personnel shortages, and trainee fire dispatching (R5)</p> <p>Consider developing procedures and plans to address the high cost implications of training state and local employees and a process to identify and track trainees (R5)</p> <p>Ensure trainees are not in assignments as primary personnel on incidents (R5)</p> <p>Investigate whether state and local employees are receiving assignments on federal fires at the expense of federal employees’ trainees (R5)</p> <p>Continue training individuals in cost share methodologies (R5)</p> <p>Identify, focus on, and encourage line officers to deal with persistent causes of increased fire cost (R1)</p>
<p>Decision Support Tool Improvements</p>	<p>Develop a standard template for DOAs with clear direction for the type of local information that should be added</p> <p>Develop a field portable tool with information and cost considerations for decision-making and capturing significant decisions (R2)</p> <p>Provide better tools, training, and support to conduct financial oversight and make determinations regarding IMT cost efficiency for all fire situations (R2)</p> <p>Work with the NIMO team to develop processes and procedures that improve wildfire decision making (R1)</p>
<p>Fire Incident Overall Strategy</p>	<p>Continue to consider wildfire use strategies based on costs, firefighter exposure, and resource benefits (R5)</p> <p>Consider historical impacts, fire conditions, weather conditions, and previous fire location in planning and selecting appropriate suppression strategy (R3)</p> <p>Ensure fire strategies recognize and use new information or differently displayed information before engaging in a decision support process (R5)</p>

Coverage Area	Regional Recommendation
	<p>Consider all factors in the development of a complexity analysis and use the tool for fire situation assessment and ordering of appropriate incident management resources (R3); follow interagency standards for preparing the incident complexity analysis (R5)</p> <p>Prepare an action plan and contingency plan for team use when resources become available (R5)</p> <p>Monitor high cost resources to identify ways to reduce dependence on these resources as well as reducing costs associated with these resources (R5)</p> <p>Continue to share resources between incidents when appropriate or when resources are scarce (R5)</p> <p>Continue to provide leadership in discussions and clarifications of structure protection (R1)</p>
<p>Fire Incident Tactical and Operational Improvements</p>	<p>Improve the contracting and procurement process to provide water association assistance in completing procurement actions (R3)</p> <p>Inform incoming personnel of the potential for abnormal fire behavior (R3)</p> <p>Show some relationship in the WFSAs between high expected losses and resource and fire management objectives described in the analysis (R5)</p> <p>Prepare WFSAs revisions when it becomes clear a fire would exceed a spending limit established in the existing WFSAs (R5)</p> <p>Ensure that the objectives guiding the WFSAs are realistic and reflect fire fuels and weather indices, resource availability, time of season, and the political situation (R3)</p> <p>Reference the selected WFSAs alternative and communicate the cost threshold for all delegations of authority (R3)</p> <p>Order a Type 1 team when recommended by the complexity analysis unless a Type 2 team is justified in writing (R5)</p> <p>Follow policy regarding the use of cellular/satellite telephones and radios for complete, documented, and relayed communications (R3)</p> <p>Ensure that a designated duty officer responds to fires and staff critical fire management positions (R3)</p> <p>Review the EaTIS program design concepts and implementation procedures to determine if it results in the most timely and cost-effective use of contractual resources (R5)</p> <p>Identify computer program issues, develop protocols and procedures for both IMTs and ASC to streamline payment document needs, etc. (R5)</p> <p>Work with NRCG partners to implement and improve the movement of fire management resources between incidents where they will be most effective (R1)</p>

Most importantly, the regional reviews indicate that past recommendations from past independent panel reviews or other sources may not have been implemented or, if implemented, have not resulted in the desired impact. For example, the April 2008 large fire cost review for the fiscal year 2007 wildland fires recommended changes in land management and fire management plans for a more strategic approach. It also advocated community action for better fire prevention planning and flexible suppression strategies and related staffing and resource support for extended fires. Cost-sharing agreements remain an issue. Local concerns regarding protecting people and privately-owned structures within federal lands or in adjacent land add to the difficulty of managing fires. Public perception of fire suppression effectiveness is often tied to the visibility of assets such as helicopters, even though those assets are not critical for, or have

little impact on fire suppression for particular fires. As will be described below, these are all factors referenced in current Forest Service doctrine and planning. However, there appears to be a large gap between doctrine and planning and actual implementation of the doctrine and plans. This point is covered in more detail with regard to costs and safety in Attachment 4.

## Past and Current Plans, Doctrine, and Operations

We recognize that past independent panel and regional recommendations informed subsequent fire management strategic plans, doctrine, and actual operations. There certainly is a large cadre of plans, for example, intended to improve wildland fire management from the National Fire Plan to the latest Forest Service performance management report. Of particular interest to us is the Ten Year Comprehensive Strategy and its most current implementation plan, the Quadrennial Fire Reviews, and the USDA Forest Service Strategic Plan FY 2007-2012, its recent performance management report, and the National Fire and Aviation Management Strategic Plan and its performance.

### Ten Year Comprehensive Strategy

In P.L. 106-291, Congress mandated the creation of a coordinated national Ten Year Comprehensive Strategy. The result was the August 2001 Ten Year Comprehensive Strategy (the Ten Year Strategy) to reduce wildland fire risk to communities and the environment. The Strategy called for a proactive, collaborative, and community-based approach to reducing wildland fires – working side-by-side with effective traditional approaches to fire suppression and fire-fighting readiness. According to the Ten Year Strategy, implementing the Comprehensive Strategy and the National Fire Plan is a top priority for the Departments of Agriculture and Interior, as well as state governors, tribes, and other interested stakeholders. It also calls for a strong collaboration framework involving complete, current, and cooperative information sharing; coordination with all stakeholders in documenting specific resource needs, goals, and objectives; and outreach to communicate the operational needs of implementing the strategy.

The Strategy goals and actions, and implementation outcome and performance measures (from the December 2006 update of the implementation plan for the Strategy) is provided in Appendix C. What is particularly valuable in the Strategy are measures that provide a very clear picture of performance and are geared towards outcomes – not processes or outputs.<sup>3</sup>

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<sup>3</sup> The 2008 Office of Management and Budget Circular No. A-11, outputs describe the level of activity that will be provided over a period of time, including a description of the characteristics (e.g., timeliness) established as standards for the activity. Outputs refer to the internal activities of a program (i.e., the products and services delivered). (p. 4 of section 200). Outcomes “describe the intended result of carrying out a program or activity. They define an event or condition that is external to the program or activity and that is of direct importance to the intended beneficiaries and/or the public. ... While performance measures must distinguish between outcomes and



## Quadrennial Fire Reviews

The five federal natural resource management agencies have also developed two quadrennial fire reviews (QFRs)—one in 2005 and 2009. As the 2005 review stated, these reviews are intended to produce a unified fire management strategic view. The 2005 review emphasized key mission strategies and core capabilities and established a focal point for establishing investment priorities. It also stressed the continuous programmatic review and investment priority impact of the QFR process. The QFRs are represented as building on past and ongoing policy and program reviews of the wildland fire community. The 2005 QFR presented 10-to-20-year projections of future conditions and risk and then described strategies for new mission requirements and building new capabilities in a 4-to-5-year period. The 2009 QFR reiterated the importance of the 2005 QFR capabilities and stressed the need for comprehensive risk evaluation and management. It also involved the National Association of State Foresters in the review process.

The QFRs provided accounts of policies and operations to improve fire management. For example, the 2005 QFR reported policy direction such as: new or revised doctrine such as the National Fire Plan, the Ten Year Comprehensive Strategy of the Western Governors Association, the Federal Fire Policy, and various legislative provisions. The QFRs have proposed new or stronger policies and operations. The 2009 QFR mentioned a new cohesive fuels treatment strategy, an updated Ten Year Comprehensive Strategy, and advances in new systems and decision support processes for fire management, such as LANDFIRE and the Fire Program Analysis.

The 2005 QFR described new integrated mission strategies and new or strengthened core capabilities. The 2009 QFR added new core strategies and advocated revising the overall fire suppression management strategy. The 2009 QFR stresses the overarching fire management commitment to safety and risk management. It described moving beyond appropriate management response to what was called strategic management response (SMR). SMR was also described as ensuring a higher level of transparency, accountability, and support for specific fire decisions and to better display the costs and benefits of suppression strategies. The SMR premise is that suppression strategy must be able to scale up to higher levels of activity and reposition more rapidly in responding to the irregular demands of asymmetric fire.

Table 3 displays the mission strategies, core capabilities, and strategy elements described in the two QFRs. The QFRs also describe workforce capacity and skill set development needs and operations, resources, and technology support for implementing the strategies. For example, the 2005 QFR mentions training capacity in incident management systems, the assessment of fire equipment

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outputs, there must be a reasonable connection between them, with outputs supporting (i.e., leading to) outcomes in a logical fashion.” (p. 3 of section 200).



resources, examination of the types and volume of contracting, and the development of large fire decision support tools.

**Table 3. QFR Mission Strategies, Capabilities, and Strategy Elements/Factors**

<b>2005 Capabilities/Strategy Elements</b>	<b>2009 Strategy Elements/Factors</b>
<p><b>Mission Strategy: Ensuring fire management’s role in ecosystem sustainability</b></p> <p>Integrating agency land management and fire management planning to align resource objectives with fire regime dynamics and promote collaboration among all stakeholders/<i>Migrate planning for fire and land management plans to the fire planning units (FPUs)</i></p> <p>Enhancing decision making for the full range of AMR and using criteria to allow for consideration of investments in reducing or maintaining fuel profiles/ <i>Expand the range of decisions under AMR and improve decision making ability and leadership skills for fire managers and line offices/agency administrators</i></p> <p>Ensuring seamless and integrated fuel programs that “strategically” treat acres/ <i>Pursue seamless integration of fuel treatment efforts in the landscape-setting priorities that reflect interagency and community priorities</i></p> <p>Establishing monitoring for adaptive management to determine whether land conditions are improving, values are being protected, and better strategies and tactics are being used/ <i>Refocus existing evaluation systems to ensure ongoing monitoring of decision making under AMR, fuel priorities, etc.</i></p> <p>Broadening ability to respond with the full range of AMR/<i>Transformation of existing team structures—away from overspecialization to national and local structures that emphasize agility and ability to respond to larger range of fire incidents</i></p>	<p><b>Mission Strategy: Suppression strategy within asymmetric fire: Moving to strategic management response (SMR)</b></p> <p>Improve wildland fire decision making and implementation through a system to document strategic decisions, facilitate access and use of next generation risk-informed decision support tools, and complete a detailed set of implementation actions</p> <p>Have land-use plans and tiered fire management planning contain strong and effective linkages to CWPPs and reflect relative costs, values, and landscape resiliency associated with proposed actions, alternatives and decisions</p> <p>Transform established plans from static, program reference documents to landscape-level strategic assessments of fire management objectives (reaching fire adapted) with strong effective linkages to NIMS compliant, CWPPs and promoting a collaborative approach for fire prevention and response planning</p> <p>Redesign IMT structures to broaden their ability to respond (range of tactics and capabilities) through more modular and meldable incident management organizations</p> <p>Invest in new aviation capabilities (modernize major parts of the aviation asset base) and apply more advanced communication and monitoring assets for fire fighting forces</p>
<p><b>Mission Strategy: Promoting fire-adapted human communities</b></p> <p>Strengthening relationships with communities at risk in the WUI to promote community self-sufficiency and collaboration on CWPPs/<i>Reemphasize local and geographic skills to strengthen working relationships at local levels especially within planning, decision making, and fuel integration</i></p> <p>Expanding community education to shape more realistic public expectations and</p>	<p><b>Mission Strategy: Achieving fire-adapted communities</b></p> <p>Create community defensible space/fuels reduction zones (treatments properly spaced and sequenced) for the WUI</p> <p>Enable (where appropriate) leave early-or-stay and defend policies for property owners</p> <p>Recalibrate public expectations in the fire adapted community era (tied to new fire outcome metrics)</p>

2005 Capabilities/Strategy Elements	2009 Strategy Elements/Factors
<p>concepts of fire adapted communities and better understanding community expectations and concern for resource values beyond protecting homes/<i>Reorient existing workforce (prevention teams, WUI specialists, and public affairs) to support public education</i></p>	<p><b>Mission Strategy: Integrated fuels portfolio in support of land management objectives</b></p> <p>Place fuel treatments based on strategic risk management or habitat protection criteria for both the WUI and to protect and enhance natural resources, such as important habitats or watersheds</p> <p>Leverage fuels treatment through cooperative state and local government programs to incentivize community efforts and build “local” fuels management capacity via grant programs and cooperative programs</p> <p>Build potential platforms to support energy production from wood and intermixing fuels reduction biomass with other woody feed stocks and agriculture residue stocks</p> <p>Use wildfire occurrence to select areas for fuel treatments, either to maintain the burned area in appropriate ecological condition, maintain fuels at a prescribed level, or take advantage of reduced fuels and risk following a wildfire</p>
<p><b>Mission Strategy: Balancing emergency response</b></p> <p>Providing training and technical assistance and creating new partnerships for learning exchange and information transfer/<i>Enhanced training capacity in incident management</i></p>	<p><b>Mission Strategy: Reshaping emergency response within fire leadership</b></p> <p>Develop the capacity of incident management organizations (types I, II, and III) so that all team members have the training and ability to address wildfire and emergency response situations, regardless of jurisdictional boundaries</p> <p>Continue to train and assist other communities and other partners in incident management and adding fire and emergency response planning to emergency response training</p> <p>Build the capability for all incident management teams to integrate and work effectively within emergency response, focusing first on local IMTs working with FEMA all hazard incident management type 3 teams and extend to national and international areas of operation</p>
	<p><b>Mission Strategy: Reimagining Wildfire in a Web 2.0 World: Creating new content, mediums, and networks for information sharing and education</b></p> <p>Expand community information sharing emphasizing real time access to public information on fire risk, prevention, and fire safety</p> <p>Enhance collaboration with stakeholders and strengthen larger community relationships and expanded public education</p> <p>Promote building and support of large networks that are concerned with land management issues and public lands restoration, without driving the inclusion of a federal design or message</p>
	<p><b>Mission Strategy: Reaffirming fire governance: Building a “new” national intergovernmental wildfire policy framework</b></p> <p>Clarify federal, tribal, state and local roles, responsibilities, and</p>

2005 Capabilities/Strategy Elements	2009 Strategy Elements/Factors
	authorities for WUI protection  Realign federal, tribal, state and local roles, responsibilities, and authorities for WUI fire protection (suppression, prevention, mitigation, and education)

## Forest Service Strategic Plans and Performance Reports

The Forest Service also published a FY 2007-2012 Strategic Plan with measures, provided in Appendix D. In the section on the Forest Service in the USDA FY 2010 Budget Justification, the agency presented wildland fire management performance measures and actual performance against FY 2008 targets. The Forest Service has struggled in meeting its strategic plan performance targets for wildland fire management and might have difficulty in meeting specified targets for 2009, 2010, and 2012. Major areas of performance emphasis were to be:

- Applying the revised guidance for the implementation of the federal wildland fire policy that allows for increased flexibility in managing unplanned ignitions.
- Developing a science-based methodology to evaluate unplanned acres burned as acres moved toward desired conditions, when outcomes are consistent with management objectives.
- Creating and implementing a process to document and display fuel treatment effectiveness where on-the-ground treatments have been tested by wildland fire.
- Increasing emphasis on assisting communities in building their capacity to respond and prepare for wildland fires.

In addition, the Forest Service Fire and Aviation Management Fiscal Year 2008 Accountability Report included a section on funding wildland fire management activities. Discussing the FY 2008 fires and activities, the Accountability Report described the continued implementation of an aggressive hazardous fuels reduction program, accelerated use of risk-informed fire management, the initiation of operational efficiencies, and continued use of management controls. Actions described in the Accountability Report include:

- Focus on hazardous fuels treatments in wildland urban interface areas and in fire-adapted ecosystems that present the greatest opportunity for restoration.
- Deploy decision support tools such as the Fire Spread Probability (FSPro) and Rapid Assessment of Values at Risk (RAVAR) models through the Wildland Fire Decision Support System (WFDSS) that support risk-informed incident management.
- Implement operational efficiencies such as managing national and critical resources for maximum flexibility.
- Deploy representatives from the Chief to interact with regional and incident leadership, introducing the concept of budgets for large fires, applying “theater” management concepts for incidents and resources, and aggressive fiscal monitoring.

- Prototype decision analyses and wildland fire policy updates to promote efficient and effective management of unplanned wildland fires.

The report noted that FAM had completed the National Fire and Aviation Management Strategic Plan in July 2008. The goals and objectives of this plan are shown in Appendix E.

## **An Actionable Framework Via the 2009 QFR and Ten Year Comprehensive Strategy**

The Forest Service FY 2010 Budget Justification Overview states that the Forest Service will continue its efforts to deploy analytic support tools to improve fire incident and program decision-making, cost containment, and agency accountability, such as FSPRO and RAVAR. These efforts are to be coupled with program reforms such as strategic and operational protocols, improved oversight, and the use of a risk management framework that ensures fire management resources are appropriately focused.

While laudable, we believe that further actions on the part of the Forest Service and its wildfire management partners that basically “continue its efforts” might result in further gaps between expected and actual performance. The two QFRs have focused on fire and fuel management in what is described as a whole-enterprise approach that might provide a better framework. The 2009 QFR posits strategic management response as a framework involving a multi-phased approach for addressing incident management, with phases of preparedness, response, strategic plans for fire on the landscape and a continual revision process. However, it is sometimes difficult to see a clear translation from the QFRs and other major policy documents such as the Ten Year Comprehensive Strategy and its implementation plan and measures to Forest Service and Fire and Aviation Management strategic goals and recent budget justification. In these documents it appears as if fire management goals may remain grounded in the individual operations of separate programs and functions with measures of process and activities, not outcomes and impacts. Implementation and assessment of expected results remain elusive. In addition, the overarching strategic goals remain safety *and* cost control, requiring considerable attention in decision-making. This point is more thoroughly covered in Attachment 4.

### **Building from the QFR and Ten Year Strategy**

We believe that the Forest Service would be well served by using the 2009 QFR and the Ten Year Comprehensive Strategy and its latest implementation plan as the starting points for new or revised strategic goals, objectives, and measures to guide the future of fire management and the stabilization of costs. These documents are pragmatic and comprehensive, drawing on past and current findings regarding fire management, provide the most current assessment of needs and direction for fire management outcomes and focus on management decisions. They make a clear distinction between what land management agencies such as the Forest Service, in partnership with others, can and cannot

affect before and during the fires season and individual fires. The “point of attack” emphasized in these documents are those areas where decisions can make a difference in overall fire management strategy and related costs.

Their explicit or implicit measures provide strong accountability. For example, one of the goals in the Ten Year Comprehensive Strategy is to reduce hazardous fuels, with a number of action steps such as ensuring communities most at risk in the WUI receive priority for hazardous fuels treatment. The implementation outcome is that hazardous fuels are treated, using appropriate tools, to reduce the risk of wildfire to communities and to the environment. The measures are very specific and outcome-oriented. They include:

- Number and percent of WUI acres treated that are identified in the CWPPs or other applicable collaboratively developed plans, and the number and percent of non-WUI acres treated that are identified through collaboration
- Number of acres treated per million dollars gross investment in WUI and non-WUI areas
- Percent of collaboratively identified high priority acres treated where fire management objectives are achieved, as identified in applicable management plans or strategies

The Forest Service FY 2007-2012 Strategic Plan measures the percentage of acres treated in the WUI interface that have been identified in CWPP or equivalent plans. Accountability could be expanded and made clearer through the adoption of additional measures, such as the other measures described in the Comprehensive Strategy and implementation plan.

### **Emphasizing Factors More Controllable by Management Action**

We recognize the importance of factors that are basically uncontrollable and uncertain. For example, past and current reports have described fire factors such as extreme fuel loading in areas that are not amenable to fuels treatment, ignition points in remote locations and burning in rugged terrain, extreme weather conditions (temperature and/or humidity), major wind or weather events that created a dramatic change in fire spread. Demographic shifts from metropolitan areas to rural areas and more development of former timberland holdings create continued wildland fire risk in the WUI, even though in the short term that shift might be mitigated by economic and energy conditions. Changed climate and vegetative conditions now drive unanticipated wildland fire expenses on fires, particularly those in the wilderness and other reserved lands. The 2009 QFR also notes the new fiscal realities of the stress on agency budgets and fire budget resources that certainly will not be mitigated in the short term. As fire events become longer, these reports point out, weather factors may yield to fuels levels as fire risk drivers. Fires are increasingly complex – multiple fires under one area management – and may be either actually or evolving to multi-jurisdictional – fires crossing federal unit boundaries onto other state, tribal, private, or community lands. In fact, sources such as the QFR describe the growing role of

tribal, state, and local level efforts – a partnership that federal land management agencies must more strongly encourage.

However, we would caution the Forest Service and other federal land management agencies from concentrating too much management attention in describing instead of managing uncontrollable or uncertain conditions. The uncontrollable or uncertain drivers of more complex, longer fires provide the context for recognizing and taking action to impact other factors that are more controllable and certain. Uncontrollable or uncertain factors such as climate change and environmental resource scarcities can be linked to preventive or mitigating action. Action can be taken, for example, to 1) better educate communities concerning the conversion of unpopulated forest and rangeland to housing in the WUI, 2) produce fire-adapted human communities where there are communities in the WUI, 3) pursue fuels treatment that produces defensible space in partnership with communities that will have a significant impact on fire risk and protection of rural communities, 4) increase community awareness and perception of firefighting outcomes and tolerance for factors such as smoke and mechanical treatments, or 5) prepare all-hazards capabilities for other demands such as emergency preparedness and response. These are the areas emphasized in the 2009 QFR and Ten Year Comprehensive Strategy and the Strategy's latest implementation plan.

In addition, we believe that the Forest Service and other federal land management agencies should more fully consider longer-term impacts that will drive wildland fire costs and even fire management strategies. For example one panel interview described how climate change and community growth increase water scarcity, which means longer hauls for water to fight fires and then for replacement of the water that was taken. That will increase costs. Changing economic conditions and the reduced demand for forest products produce declining communities that makes it difficult to attract Forest Service staff to rural, more remote areas, resulting in a Forest Service “distant” from specific land knowledge. Economic conditions force communities to reduce their own support for fire fighting, increasing pressure on state and federal response. WUI growth creates ongoing and growing concern about the impact on health, local industries, and structure protection. It also complicates inter- and intra-jurisdictional roles and responsibilities, cost sharing, and accountability and enforcement of policies such as defensible space.

### **Recognizing Causes and Linking to Actions**

In addition, one of the missing pieces in current Forest Service strategic planning appears to be *ongoing*, systematic recognition and reassessment of the causes of unwanted conditions and subsequent linkage of these to appropriate management actions. As pointed out earlier, past independent panel reviews have discussed causes of conditions. Current and future reviews will provide additional information, but the process of identification of conditions and causes must be ongoing, as is evident in the QFRs.



For example, the 2008 National Park Service (NPS) Wildland Fire Management Strategic Plan describes critical success factors (major items or issues that must go right to achieve one or more objectives), barriers (existing or potential challenges that hinder the achievement of one or more objectives), and strategies (broad activities required to achieve an objective, control a critical success factor, or overcome a barrier). Action plans then would detail the specific steps to be taken to implement a strategy, including what will be done, by whom, and by when.

To illustrate, the NPS Plan has one goal – to protect values through effective risk management – with objectives ranging from timely implementation of emergency stabilization and burned area rehabilitation, to promoting a culture that emphasizes safety awareness. Critical success factors include 1) knowledge of policy and standard operating practices, 2) knowledge of level of risk, location of risk, and values to be protected, 3) agency administrator support for high risk decisions, 4) adequate staffing and equipment, 5) educating park staff and stakeholders on the need to have fuel reduction projects, 6) culture where questions can be asked and there can be refusals to do perceived unsafe things, and 7) accurate, accessible safety reporting program. Barriers include 1) numerous and diverse opinions by stakeholders, 2) lack of process and incentives for CWPP, 3) shortage of resource management staff to participate in Burned Area Emergency Rehabilitation (BAER) planning, 4) limited integration between NPS and interagency wildland fire safety programs, and 5) insufficient safety leadership from line officers.

Overall, it should be considered whether the fire seasons of 2007 and now 2008 are now normal. In panel interviews, the 2008 large fire season was described as unique and unprecedented, often along the lines of a 100-year flood. It is not clear whether that is necessarily true. Are the conditions now much more constant for large, multiple fire events? If so, what are the implications for wildland fire planning and resource commitments. The Forest Service will need to grapple with the demands of high consequence, low probability fires such as those early in 2008 or low consequence, high probability fires that now are “caught” at a very high rate. To address both, the Forest Service will need to continue to assess the adequacy of its base capabilities and those needed to meet the surge of multiple fire ignitions in problematic areas across a wide geographic expanse.

## **A Model for Scoping Future Reviews**

The call for assessments and reviews will be ongoing, and in fact, is required by law. In response to the Government Performance and Results Act requirements, the Forest Service FY 2007-2012 Strategic Plan discusses planned program evaluations to establish or revise goals and objectives. The National Interagency Fire Center issued, in January 2009, Interagency Standards for Fire and Fire Aviation Operations. Chapter 18 covers reviews, investigations, and analyses. The review types include: preparedness, after action, fire and aviation safety team, aviation safety assistance team, national cost oversight team, individual



fire, lessons learned review, and escaped prescribed fire. The independent large fire cost panel is also required. New requirements such as decision logs increase reporting requirements and are described as being duplicative of other reporting and documentation requirements.

We are concerned that these many points of assessment and reporting and subsequent evaluation by other parties are simply substituting “volume” for “substance.” Seas of report binders, report jackets, and complex databases can create an illusion of action, but not real action. In fact, they often are duplicative and burdensome, using scarce resources toward an uncertain end. The Panel heard that often regional reviews or other assessments never are shared with those who were interviewed as part of the review. The reviews also duplicate areas of coverage of other reviews, including those of the panel. Those the panel interviewed often mentioned that reviews during fire event(s) are useful if they have a clear purpose to provide new/additional insights into strategy as part of a supportive approach to decision-making. Visits to simply gather information, or to observe, create considerable burden on the fire staff, detracting from firefighting efforts, and often lead to no feedback or negative feedback well after a fire event.

We believe the Forest Service would be well-served to examine whether these internal and external evaluations and reviews, particularly at the regional and forest level, create value above and beyond the costs of producing them. All assessments and evaluation should lead to better fire management within a fire and during a fire seasons, and then point to lessons to be learned (or re-learned) and addressed through management action.

In addition, the Forest Service should consider who should conduct the internal and external reviews if principles such as integrity, objectivity, and independence are to be served. There should be a clear separation of purpose if individual reviews are to serve different audiences and objectives. For example, reviews by the Chief’s Principal Representative or the Regional Forester Representative during a fire can serve to ensure full understanding and agreement on the fire strategy, and thus ownership of the strategy when certification is involved (sharing the risk concept). Regional large fire reviews are problematic in terms of timeliness, assessment coverage, independence, and visibility across the fire management community.

Chief’s principal representative and/or national forester representative reviews with a small supporting team might be more useful in the midst of a fire anticipated to be large to facilitate and gain ownership of the decisions that are made. Post-action reviews might be a better mechanism for sharing lessons learned and sharing on a national basis. The bottom line is that each large fire should not be reviewed up to five or six times covering the same ground, as is now currently the case.

In interviews we heard that reviews before, during, and/or after a fire should have 1) a clear charter, 2) specific methodology and data needs clearly linked to the review objectives, 3) firm schedule versus ad hoc, 4) produce a deliverable

within specific deadlines (or immediately if the purpose is consultation during an event) clearly related to better practices or actionable items for future improvement, 5) findings consistent with the exit interviews or observations during the fine, and 6) be widely shared for maximum learning.

We believe that one starting point is returning to the recommendations of the 2007 Brookings report regarding oversight, with some modifications. The Brookings panel proposed an oversight model that emphasized two major review perspectives. One was to differentiate fire season and individual fire management and resulting recommendations into three basic decision spaces: 1) preparedness and capabilities before fire season, 2) fire management during the term of the fire season and individual fires, and 3) any post-fire season and individual fire management lessons learned (or unlearned) and better practices for the next fire season. It also made a distinction between the role of internal and external review parties and streamlined the review approaches. We agree with the 2007 panel that many of the issues driving costs clearly can be roughly separated into these three decision space time frames, although a continuous learning process should not be lost. For example, preparedness before fire season such as clarifying jurisdictional authorities, ensuring that the FMP and LMP are current and useful for fire attack and suppression activities, and developing scenarios for long-term fires all can aid in fire management decisions and ultimately costs. The second perspective emphasized by the 2007 panel was to consider operational versus strategic concerns. At the strategic level, assessments of how well the FMP and LMP are utilized and identification of resource shortages are central to fire management decision-making. Operational concerns would include, for example, incident management team selection and transition. Table 4 provides an overview of this alternative model and examples of coverage.

**Table 4. Oversight Review Model**

<b>Decision Focus</b>	<b>Pre-Fire (Preparedness)</b>	<b>Fire Event (Response)</b>	<b>Immediate Post-Fire (Better Practices)</b>
<b><i>Fire Review Selection Criteria</i></b>	None: unit of analysis national forests and districts to mitigate fire impact and related cost potential	During or immediately after the end of the fire: All fires over criteria such as \$10 million in cost and/or with major community impacts	All fires over \$15 million in cost and/or with major impacts
<b><i>Strategic</i></b>			
Methodology	National Forest/district ranger self-assessment and report to the Washington Office using set criteria; posting to national website	Independent internal team (CPR or RFR lead) using set criteria, issuance of regional and national “roll-up” reports	National independent panel review, issuance of national report
Coverage Examples	Jurisdictional authority, roles, and responsibilities for WUI protection  FMP and LMP coverage of	FMP and LMP utilization  IMT structure and support flexibility and	Examination and analysis of after action reports  In-depth fire site visits to further examine strategic concerns,

<b>Decision Focus</b>	<b>Pre-Fire (Preparedness)</b>	<b>Fire Event (Response)</b>	<b>Immediate Post-Fire (Better Practices)</b>
	<p>fire frequency and hazardous fuels treatments, currency, and integration</p> <p>Use of scenarios and exercises to (1) anticipate short and long-term fires and complexity given drought and fire severity indices and the reduction of natural barriers and (2) decision alternatives and strategies agreeable to all involved stakeholders</p> <p>Availability of trained decision support system analysts</p> <p>Risk management, values at risk identification (WUI considerations); impact of fuels treatment</p> <p>Community wildfire protection plans and defensible space</p> <p>Community outreach and education plans and information sharing systems</p>	<p>adaptability</p> <p>Cost and safety considerations; other resource availability and constraints</p> <p>Cost efficiency actions</p> <p>Appropriateness of strategies, e.g., direct and indirect suppression activities, point suppression, determination of complexes and theatres, determination of campaign fires</p>	<p>identify and assess "successful fire" metrics and possible better practices for national application</p> <p>Review of other management and accomplishment reports</p> <p>Review of complete cost cycle of large wildfires and assessment of losses averted</p>
<b><i>Operational</i></b>			
Methodology	National forest and district review using set criteria; report to regional forester	Independent internal team (CPR or RFR lead) using set criteria, findings provided to the host unit immediately	National independent panel review, issuance of national report
Coverage Examples	<p>Memorandums of understanding; cost sharing and cost apportionment agreements; local contracts</p> <p>Analytical tool expertise</p> <p>Resource and business planning and guidelines</p> <p>Community wildfire protection plan implementation and collaboration</p>	<p>SMR/AMR and suppression alternatives</p> <p>Tool utilization and impacts</p> <p>Resource availability and constraints</p> <p>Cost efficiency actions</p> <p>National team rotations and capability to meet fire's specific needs</p>	<p>Examination and analysis of CPR and/or RFR team reports</p> <p>In-depth fire site visits to further examine operational concerns, identify and assess possible better practices</p> <p>Review of other management and accomplishment reports</p>

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## APPENDIX A: INDEPENDENT PANEL FINDINGS AND RECOMMENDATIONS

Topic	Condition/Cause	Recommendation: Desired State (Source)
Land Management Plans (LMPs)	<p><u>Condition:</u> LMPs are often decades old and do not reflect changed ecosystem conditions. The old LMPs constrain the scope and effect of more current FMPs. The LMPs do not provide a detailed discussion of a) fire history of past fire behavior and an indication of the types of fires expected; b) the types of fuels, typical fuel levels, and hazard fuel reduction treatments; c) the presence of communities and structures adjacent to and intermixed in the area and expected changes in demographics; d) the use of fire to accomplish resource management objectives; and e) the application of Appropriate Management Response strategy to the management of a fire in LMPs revised since 2000 or a discussion of using appropriate suppression response measures in earlier LMPs.</p> <p><u>Cause:</u> The length of time it takes to develop an LMP may be eclipsing the ability of a plan to consider current fire effects. There are significant legal challenges and political obstacles that confront federal LMP revision efforts.</p>	<p>None explicitly stated. (Brookings 2008; Ferraro 2006, 2005)</p> <p>Develop guidance for future revisions of LMPs to incorporate elements of the importance of fuels reduction activities, fire history, changes in the WUI, and how these elements impact land management. (Brookings 2007)</p>
Appropriate Management Response	<p><u>Condition:</u> The LMPs generally did not discuss AMR. AMR is not understandable to the public and neighboring partners and there are not consistent definitions across the Forest Service regions and the five federal agencies.</p> <p><u>Cause:</u> See discussion on LMPs.</p>	<p>Continue expanding Appropriate Management Response guidance on FMPs beyond the model and textual boilerplate with an aim to increasing “transparency” on the range of suppression tactics and alternatives, consistent definitions, clarification of the current array of fire operational strategies, and techniques for developing strategic opportunities. (Brookings 2007, 2008)</p>
Fire Management Plans (FMP)	<p><u>Condition:</u> FMPs were often not current and when updated, the level of change was very minimal and often did not address key component changes. FMPs do not have sufficient detail and discussion of key elements to provide significant information and direction for developing an effective fire management strategy or to share with neighboring communities and other jurisdictions. Plans do not have a detailed discussion of cost containment and wild fire use.</p> <p><u>Cause:</u> Many units do not see FMPs as strategic documents in fire management; they are seen as a repository for fire management written policies, operational processes, communications information, and corresponding documents, with new or revised policies added as appendices. Unresolved legal challenges also curb the desire to significantly revise an FMP.</p>	<p>Transform FMPs from static, updated program reference documents to more strategic assessments of fire management planning and policies, and develop a more selective approach to FMP revision. (Brookings 2007, 2008)</p>
Federal and Non-Federal Jurisdictional Collaboration	<p><u>Condition:</u> Discussions among federal land managers and neighboring jurisdictions is generally limited to cost share agreements, protection boundaries, evacuation plans and occasional fuels treatment projects, not jurisdictional land and resource objectives, perceptions of fire risk and cost, and environmental outcomes.</p> <p><u>Cause:</u> While there is enthusiasm for CWPPs and recognition of their potential, there was not a commitment by federal units to collaborate with communities in their FMP processes or integrating community CWPP efforts with</p>	<p>Create a stronger linkage from FMPs to Community Wildlife Protection Plans by creating a more collaborative approach for fire prevention planning than exists now. (Brookings 2007, 2008)</p>

Topic	Condition/Cause	Recommendation: Desired State (Source)
Fuels Treatment Backlog	<p>federal fire prevention and suppression planning.</p> <p><i>Condition:</i> Pre-incident fuel treatments were limited and dramatically below inventoried levels. Wildland fire use faces barriers as a strategy for reducing fuel levels at the landscape level.</p> <p><i>Cause:</i> Limited budgets constrain fuel treatments. Wildland fire use is still a new concept. There is concern about the spread of wildland fire use fires off of national lands.</p>	None explicitly stated.(Ferraro 2005)
Wildland Fire Situational Analysis and Decision Support Tools	<p><i>Conditions:</i> The Delegation of Authority letters did not provide realistic cost objectives nor performance measures for cost management, nor establishing suppression resource priorities to complex incidents. Some WFSAs did not meet fire management objectives of all fires in a complex and for multiple decisions and trigger points. Strategies and trigger points identified in the WFSAs were often at odds with other jurisdictional interests. Long Term Implementation Plans did not include a section on cost containment strategies or cost behavior strategies for a long-duration fire.</p> <p><i>Cause:</i> Units generally had problems with the use of and confidence in the decision support tools in assisting in formulating suppression strategies. There was no clear pattern for the preparation of a new WFSAs. WFSAs process was often treated by IMTs more as an obligatory document than a guiding strategic suppression tool. WFSAs did not have adequate senior line management oversight.</p>	<p>Encourage more collaboration in the WFSAs process. (Brookings 2007)</p> <p>Address options for short term and long term management of suppression resources. (Brookings 2007)</p> <p>Make delegation of authority letters strategic documents to contain specific statements outlining larger suppression objectives, resource values and final restoration concerns, expectations about containing fire cost growth, and performance measures for successful suppression, cost management, and public and firefighter safety. (Brookings 2007)</p> <p>Ensure that the next generation of decisional support processes for predicting fire risk and potential fire size learns from the WFSAs process. (Brookings 2008)</p>
Decision Space for Agency Administrators and IMTs	<p><i>Condition:</i> The rate of expenditure of a type 1 or 2 IMT is consistent. There is little variance in the mix of resources deployed.</p> <p><i>Cause:</i> Wildfire expenses may be driven more by national and regional policies than any other factor. AAs and IMTs are assigned multiple protection objectives by regulations, policies, land management objectives, public expectations, and organizational guidelines. Layers of rigid constraints cause reduced decision space. There is a uniformity of suppression strategy.</p>	<p>Perform a resource optimization analysis for extended attack to compare the contribution of additional resources per unit of cost.(Ferraro 2005)</p> <p>Reconcile national, state, and regional contract standards. (Ferraro 2005)</p>
Incident Management Team Structure, Staffing, Transitioning, and Resourcing	<p><i>Conditions:</i> Assets are reassigned daily based on demand and while a good example of demand responsive fire suppression management, the process makes it difficult to determine and assign the appropriate supply and type of assets. IMT assignment limits do not reflect short fire or longer fire rotation needs and increase transitions. Transition to lower level IMTs are delayed due to lack of capacity.</p> <p><i>Cause:</i> National fire resources have national utilization, high demand, limited availability, and unique status-reporting requirements. IMTs are founded on consistency and reliability with limited operational and functional flexibility and agility, particularly overhead personnel. What is made available for fire support is often determined more by supply than fire management need.</p>	<p>Tailor more agile IMTs to fit the needs of the incident (Brookings 2007)</p> <p>Enhance local type 3 IMTs to provide for a more robust capability during incident closeout (Brookings 2007)</p> <p>Explore alternative strategies that allow greater degrees of flexibility when committing IMTs to prolonged large fire operations (Brookings 2007)</p> <p>Continue to pursue more flexible suppression strategies, especially on extended fires, matched with more judicious staffing and resource levels. (Brookings 2008)</p> <p>Conduct rigorous needs analyses of the suppression role of national resources. (Ferraro 2006, 2005)</p>
Collaborative Cost	<p><i>Condition:</i> How to achieve cost management other than exercising various forms of fiscal vigilance on resource</p>	Formulate a collaborative cost management strategy that provides a



Topic	Condition/Cause	Recommendation: Desired State (Source)
Management Strategy	<p>ordering and usage is unclear. The complete cost cycle on large wildfires is not understood. The IBA has a marginal impact on reducing fire suppression costs. Procurement and acquisition does not recognize the difference between a short or long term event.</p> <p><i>Cause:</i> Costs are not individually tracked from fire origin to completion of the burned area emergency restoration work. The current use of IBAs is primarily ensuring cost accountability and focused on fiscal integrity. Pre-fire discussions are not done to narrow the cost differences between federal, state, and contractor costs and to size the pool of resources in advance of reaching the highest preparedness levels.</p>	<p>better picture of fire suppression costs over the incident span. (Brookings 2007)</p>
Off-Forest Values	<p><i>Condition:</i> Every available resource, regardless of cost, is used to control a large fire and/or protect structures.</p> <p><i>Cause:</i> Suppression expenses escalate when private inholdings, other ownership lands, and infrastructure adjoin national forests. Agency administrators and incident commanders face strong social and political pressure to protect off-forest values from the effects of wildfires on national forests. Forest Service direction did not provide fiscal limitations direction regarding responsibility for management of wildland fires that threaten other jurisdictions.</p>	<p>Provide standards and clarification to field units about how much effort should be expended to prevent wildland fires from escaping onto other jurisdictions or. (Ferraro 2006, 2005)</p> <p>Provide clarification as to if, or how, suppression costs should be apportioned with threatened jurisdictions. (Ferraro 2006)</p>
Reviews, Reports, and Outcome Metrics	<p><i>Condition:</i> The utility and value of cost containment reviews appears limited. External reviews heavily emphasized operational and process issues that are very insignificant in impacting fire costs. Some reviews were internally or externally inconsistent or did not clearly link cause, condition, and the effect of problems.</p> <p><i>Cause:</i> Expense accountability was emphasized over suppression total cost-effectiveness. There is no national or regional standard of analysis and no formalized mechanism for dissemination of the data and conclusions back to local managers and national level reviews are not being completed by the national office. An integrated review approach and evaluative framework from individual fires to national strategies was not used. Reviews did not provide the best picture of how wildland fires are being managed, including cost perspectives.</p>	<p>Revise the thresholds and selection criteria for regional and national reviews and tier the evaluation objectives of reviews so that they are more strategically-based assessments of progress made towards desired outcomes. (Brookings 2008)</p> <p>Re-evaluate the policy of conducting cost containment reviews. (Ferraro 2006)</p>
	<p><i>Condition:</i> Fire outcomes are measured in terms of cost per acre. There is no metric that balances the number of acres protected when tallying money spent in suppression.</p> <p><i>Cause:</i> Fire outcomes with costs and benefits are not identified. There is no consideration as to whether a fire should have been suppressed in the first place.</p>	<p>Develop a better set of outcome metrics for fire management to capture the concept of investment and the complete cost cycle on large wildfires from initial attack to landscape restoration and incorporating some calculation of losses averted in terms of public safety. (Brookings 2007, 2008)</p>
National Policies: Firefighter and Public Safety	<p><i>Condition:</i> Fires escaped initial attack or were not contained at smaller sizes.</p> <p><i>Cause:</i> There is an excessive focus on safety and low risk tolerance. Safety approaches included resistance to using night shifts, frequent use of indirect fire tactics, and reliance on expensive aviation resources instead of less expensive ground resources.</p>	<p>No direct recommendation. The panel noted the agency did have an increasing emphasis on safety but was shifting from a rules-based approach to wildland fire safety towards a principle-based approach requiring situational judgment. (Ferraro 2006, 2005)</p>

## APPENDIX B. MAJOR REGION REPORT CONCERNS

Assessment Elements	Rocky Mountain Region (R2)	Southwestern Region (R3) <sup>4</sup>	Pacific Southwest Region (R5)	Pacific Northwest Region (R6)
<p><b>Sufficient and Reliable Information</b></p> <ul style="list-style-type: none"> <li>✓ Access of line officers and incident commanders to necessary and sufficient reliable information to best manage the fire</li> <li>✓ Linkage of the LMP and FMP and their direction to inform wildfire suppression strategies</li> <li>✓ Sufficiency of delegation of authorities in guiding protection and cost containment</li> </ul>	<p>Confusion concerning number and approval of personnel for a Type I team</p> <p>Inadequate understanding of the viability and use of the SCI</p> <p>Inadequate understanding if SCI fires are valid for actual fire comparison</p>	<p>Many factors hampered initial attack (lack of pre-season agreements unknown or underutilized aviation assets; acting managers; communication breakdowns, AA lacked key information, suspension of night operations not supported in fire management plan)</p>	<p>WFSA and DOAs served as primary documents for AA direction but there was a heavy reliance on personal interactions for conveying information or concerns related to LMPs and FMPs to incident personnel</p> <p>Fire management direction and objectives for wilderness, late successional forest reserves, and riparian reserves provided to IMTs are confusing when there is overlapping or adjacent fires</p> <p>Some DOAs were very general and lacked specificity or emphasis on cost containment and information on LMPs, FMPs, and AA expectations; DOAs at times did not identify either the selected suppression alternative, describe the fire management strategy, cite the cost limit, or provide specific standards for fiscal responsibility or accountability</p>	<p>DOAs generally did not provide specific cost containment expectations and identify areas that significantly affect costs</p>
<p><b>Social Factors</b></p> <ul style="list-style-type: none"> <li>✓ Identification of social and political factors driving fire costs</li> <li>✓ Satisfaction of social and political factors and to what extent</li> <li>✓ Cost impact of mitigating social and/or political factors</li> </ul>	<p>Heavy helicopters, while visible, in some instances operated with little effect on the spread of the fire</p>	<p>Community concerns with wildland fire suppression following 2007 fire</p> <p>Water use payment delays for 2007 fires hampered relationships with vendors</p> <p>Lack of documentation of pre-season agreements of water resources</p>	<p>Protection of values in the WUI and cooperator jurisdictions result in major cost expenditures to keep fire from advancing on private lands or cooperator jurisdictions</p>	<p>No concerns identified</p>
<p><b>Risk Management</b></p> <ul style="list-style-type: none"> <li>✓ Identification of fire threats to specific</li> </ul>	<p>Protection of private structures where fire protection</p>	<p>Fire management plan and operations guide not fully followed</p>	<p>In some cases, WFSA strategies relied on suppression resources that were not likely to be available;</p>	<p>No concerns identified</p>

<sup>4</sup> Where the region separated findings and concerns by fire, the Panel only included information on fires over \$10 million in costs, such as the Trigo fire. The Intermountain Region and Northern Region reviews did not have fires over \$10 million in costs.

Assessment Elements	Rocky Mountain Region (R2)	Southwestern Region (R3) <sup>4</sup>	Pacific Southwest Region (R5)	Pacific Northwest Region (R6)
<p>values</p> <ul style="list-style-type: none"> <li>✓ Decision process that balances threats to values with the acceptability of costs</li> <li>✓ Risk sharing with the general public and local, state, and federal agencies</li> <li>✓ Decision improvements or changes to help decisions on future fires</li> </ul>	<p>was a local responsibility</p> <p>Highway traffic congestion created hazards</p> <p>Least cost alternatives not selected as politically unacceptable</p>	<p>Initial complexity analysis did not take into account resources ordered, air operations, initial attack resources, sits, and wilderness designation</p> <p>Numerous transitions of incident management leadership</p> <p>Lack of fuels modifications around structures by private owners</p>	<p>WFSA may reflect a pre-disposed strategy and not be used as a decision support tool</p> <p>In some cases, a complete listing and consideration of values-at-risk might have narrowed the distance between the estimated cost of suppression and the values-at-risk</p> <p>Lack of clarity why the Forest Service should share the cost of local structure protection outside of its protection area and where local and state government fire protection entities exist</p> <p>WFSA does not include recreation objectives other than safety concerns</p> <p>In one case, the selected WFSA alternative cost estimate vastly exceeded the final cost despite daily review and validation of the WFSA</p> <p>Some complexity analyses were incomplete or missing in available documentation</p> <p>Costs are added in protecting buildings and human life by keeping fires within federal protection areas even though a better suppression point would be outside the protection area; all costs born by federal agencies</p> <p>Wildland fire use strategies suspended and led to ordering IMT</p>	
<p><b>Strategic and Tactical Decisions</b></p> <ul style="list-style-type: none"> <li>✓ IMT and ACC actions to control costs on their own</li> <li>✓ Direction from others for IMT and ACC action to control costs</li> <li>✓ Impact of resource availability, capability, or efficiency on tactical decisions, size, and/or final fire cost</li> </ul>	<p>Transition from fire use for resource benefit to fire suppression created perception differences between IMT and agency line and staff</p> <p>Difficulties with Type I mobilization regarding personnel, rental cars, and other</p>	<p>Breakdown in communications regarding dip site location useful for initial and extended attack</p> <p>Private water sources unknown or reluctance to use without an agreement</p> <p>Lack of awareness of potential availability of helicopters</p> <p>Inefficient location of helicopter staging area lack of initial agreements</p>	<p>A high percentage of the trainees are local and state employees with very high costs per person</p> <p>Trainees used for unable to fill positions which may not ensure a quality training assignment</p> <p>No process in place to track or identify local and state trainees on federal fires</p> <p>California cost share and cost apportionment agreements can become extremely complex and contentious</p>	<p>No concerns identified</p>

Assessment Elements	Rocky Mountain Region (R2)	Southwestern Region (R3) <sup>4</sup>	Pacific Southwest Region (R5)	Pacific Northwest Region (R6)
✓ Impact of AA direction on overall fire costs	logistical support	<p>for land use</p> <p>Fire Management Plan not signed, dated, or updated</p> <p>Lack of awareness or application of fire behavior from earlier fire with similar conditions</p> <p>Cell phone use hampered completeness and documentation of dispatch and fire personnel communications</p> <p>Considerable fire leadership positions acting, less experienced</p> <p>WFSA decision support not reflective of fire fuels and weather indices, resource availability, time of season, and the political situation</p> <p>Delegation of authority missing selected suppression alternative and cost threshold</p> <p>Excess hours worked per day</p> <p>Large numbers of trainees ordered without a geographic plan or focus</p>	<p>One fire cost sharing agreement was not in compliance with the CFMA</p> <p>Continued use and reliance on non-federal resources and trainees continues to significantly contribute to total costs</p> <p>Non-EaTIS equipment was required to be replaced by EaTIS equipment regardless of critical needs, cost-effectiveness, or local of the equipment</p> <p>Discrepancies and time delays in populating interrelated computer programs</p> <p>In one instance, little or no communication with partner agencies and CALFIRE concerned fire was approaching their protection area</p>	

## APPENDIX C. TEN YEAR COMPREHENSIVE STRATEGY GOALS, IMPLEMENTATION OUTCOMES AND PERFORMANCE MEASURES

Goal	Actions	Implementation Outcome and Measures
<b>Improve prevention and suppression</b>	<ul style="list-style-type: none"> <li>• Improve federal, state, and local firefighting resource capability and readiness to protect communities and the environment from wildland fires</li> <li>• Reduce the incidence of injury to life and property resulting from catastrophic wildland fires</li> <li>• Expand outreach and education to homeowners and communities about fire prevention through use of programs such as “Firewise”</li> <li>• Develop a consistent preparedness planning model, among the federal agencies and others, that analyzes cost-effective fire protection among all administrative boundaries</li> </ul>	<p>Losses of life are eliminated, and firefighter injuries and damage to communities and the environment from wildfires are reduced</p> <p>Measures:</p> <ul style="list-style-type: none"> <li>• Percent change from 10-year average for percent of wildfires controlled during initial attack and number of unwanted human-caused wildfires</li> <li>• Percent of fires not contained in initial attack that exceed a stratified cost index</li> </ul>
<b>Reduce hazardous fuels</b>	<ul style="list-style-type: none"> <li>• Reduce the total number of acres at risk to severe wildland fire</li> <li>• Ensure communities most at risk in the wildland-urban interface receive priority for hazardous fuels treatment</li> <li>• Expand and improve integration of the hazardous fuels management program to reduce severe wildland fires to protect communities and the environment</li> <li>• Incorporate public health and environmental quality considerations in the fire management activities undertaken for the hazardous fuels management program</li> <li>• Develop smoke management plans in conjunction with prescribed fire planning and implementation</li> <li>• Develop strategies to address fire-prone ecosystem problems that augment fire risk or threaten sustainability of these areas</li> <li>• Assure maintenance of areas improved by fuels treatment by managing activities permitted on the restored lands to maintain their resiliency</li> <li>• Conduct and utilize research to support the reduction of hazardous fuels in wildland urban interface communities and environments</li> <li>• Ensure local environmental conditions are factored into hazardous fuels treatment planning</li> </ul>	<p>Hazardous fuels are treated, using appropriate tools, to reduce the risk of wildfire to communities and to the environment</p> <p>Measures:</p> <ul style="list-style-type: none"> <li>• Number and percent of WUI acres treated that are identified in the CWPPs or other applicable collaboratively developed plans, and the number and percent of non-WUI acres treated that are identified through collaboration</li> <li>• Number of acres treated per million dollars gross investment in WUI and non-WUI areas</li> <li>• Percent of collaboratively identified high priority acres treated where fire management objectives are achieved as identified in applicable management plans or strategies</li> </ul>
<b>Restoration and post-fire recovery of fire-</b>	<ul style="list-style-type: none"> <li>• In the short-term, perform burned area emergency stabilization and rehabilitation work to protect life and property, protect municipal watersheds, and prevent</li> </ul>	<p>Part A: Restoration of Fire-Adapted Ecosystems</p> <p>Fire-adapted ecosystems are restored and</p>

Goal	Actions	Implementation Outcome and Measures
<b>adopted ecosystems</b>	<p>further degradation of critical cultural and natural resources</p> <ul style="list-style-type: none"> <li>In the long-term, restore burned areas and repair and improve lands unlikely to recover naturally from severe fire damage</li> <li>Place priority on at risk watersheds that have been damaged by wildland fire</li> <li>Promote the establishment of sources of native seed and other plant material</li> <li>Promote awareness of and training in the use of minimum impact suppression activities</li> <li>Promote research and effective use of restoration and rehabilitation treatments</li> <li>Eradicate or minimize the rate of spread of invasive species that negatively impact natural fire cycles and fire-adapted ecosystems</li> <li>Improve the capability to decrease invasive species in burned areas through research and development</li> <li>Research interactions between fire, land management actions, and other disturbances, and apply lessons learned to future management decisions</li> </ul>	<p>maintained, using appropriate tools, in a manner that will provide sustainable environmental, social, and economic benefits</p> <p>Measures:</p> <ul style="list-style-type: none"> <li>Number and percent of acres treated, through collaboration, identified by treatment category (i.e., prescribed fire, mechanical, and wildland fire use)</li> <li>Percent of the natural ignitions occurring in areas designated for wildland fire use or consistent with wildland fire use strategies that are allowed to burn and the number of acres burned</li> <li>Number and percent of acres treated to restore fire-adapted ecosystems which are moved toward desired conditions and maintained in desired conditions</li> </ul> <p>Part B: Post-Fire Recovery of Fire-Adapted Ecosystems</p> <p>Lands damaged by wildfire recover to a desired condition</p> <p>Measures:</p> <ul style="list-style-type: none"> <li>Percent and number of burned acres identified in approved post-wildfire recovery plans as needing treatments that actually receive treatments</li> <li>Percent of burned acres treated for post-wildfire recovery that are trending toward desired conditions</li> </ul>
<b>Promote community assistance</b>	<ul style="list-style-type: none"> <li>Reduce the losses to communities and individuals from wildland fire</li> <li>Promote markets for traditionally underutilized wood as a value-added outlet for by-products for hazardous fuel reduction and ecosystem restoration efforts</li> <li>Promote opportunities to continue and enhance sustainable livestock grazing as part of protection and restoration strategies</li> <li>Increase incentives for private landowners to address defensible space and fuels management needs on private property through local land use policies</li> <li>Promote local government initiatives to implement fire-sensitive land use planning</li> <li>Promote public knowledge and understanding of wildland fire, including risks and the role of fire in natural ecosystem processes</li> </ul>	<p>Communities-at-risk have increased capacity to prevent losses from wildland fire and realize economic benefits resulting from treatments and services</p> <p>Measures:</p> <ul style="list-style-type: none"> <li>Number and percent of communities-at-risk covered by a CWPP or equivalent that are reducing their risk from wildland fire</li> <li>Percentage of at risk communities who report increased local suppression capacity as evidenced by a) the increasing number of trained and/or certified fire fighters or crews, or b) upgraded or new fire suppression equipment obtained, or c) formation of a new fire department or expansion of an existing department involved in wildland fire fighting</li> <li>Number of green tons and/or volume of woody biomass from hazardous fuel</li> </ul>

<b>Goal</b>	<b>Actions</b>	<b>Implementation Outcome and Measures</b>
		reduction and restoration treatments on federal land that are made available for utilization through permits, contracts, grants, agreements, or equivalent



## APPENDIX D. FOREST SERVICE FY 2007-2012 STRATEGIC PLAN GOALS, OUTCOMES, OBJECTIVES, AND PERFORMANCE MEASURES

Goal and Outcome	2007-2012 Objectives and Measures
<p><b>Restore, Sustain, and Enhance the Nation's Forests and Grasslands</b></p> <p>Forests and grasslands with the capacity to maintain their health, productivity, diversity, and resistance to unnaturally severe disturbance</p>	<p>1.1 Reduce the risk to communities and natural resources from wildfires</p> <p style="padding-left: 20px;"><i>Number and percentage of acres treated to restore fire-adapted ecosystems that are (1) moved toward desired conditions and (2) maintained in desired conditions</i></p> <p style="padding-left: 20px;"><i>Number of acres brought into stewardship contracts</i></p> <p>1.2 Suppress wildfires efficiently and effectively</p> <p style="padding-left: 20px;"><i>Percentage of fires not contained in initial attack that exceed a stratified cost index</i></p> <p>1.3 Build community capacity to suppress and reduce losses from wildfires</p> <p style="padding-left: 20px;"><i>Percentage of acres treated in the wildland-urban interface that have been identified in CWPP or equivalent plans</i></p> <p>1.4 Reduce adverse impacts from invasive and native species, pests, and diseases</p> <p style="padding-left: 20px;"><i>Percentage of priority acres restored and/or protected from invasive species on federal and cooperative program lands</i></p> <p>1.5 Restore and maintain healthy watersheds and diverse habitats</p> <p style="padding-left: 20px;"><i>Percentage of watershed in class 1 condition</i></p> <p style="padding-left: 20px;"><i>Acres and miles of terrestrial and aquatic habitat restored consistent with forest plan direction</i></p> <p style="padding-left: 20px;"><i>Percentage of acres needing reforestation or timber stand improvement that were treated</i></p>
<p><b>Provide and Sustain Benefits to the American People</b></p> <p>Forests and grasslands with sufficient long-term multiple socioeconomic benefits to meet the needs of society</p>	<p>2.1 Provide a reliable supply of forest products over time that (1) is consistent with achieving desired conditions on NFS lands and (2) helps maintain or create processing capacity and infrastructure in local communities</p> <p style="padding-left: 20px;"><i>Amount of wood fiber provided each year to help meet the nation's demand for forest products in an environmentally sustainable manner</i></p> <p style="padding-left: 20px;"><i>Number of green tons and/or volume of woody biomass from hazardous fuel reduction and restoration treatments on federal land that are made available through permits, contracts, grants, agreements, or the equivalent</i></p> <p>2.2 Provide a reliable supply of rangeland products over time that (1) is consistent with achieving desired conditions on NFS lands and (2) helps support ranching in local communities</p> <p style="padding-left: 20px;"><i>Acres of national forests and grasslands under grazing permit that are sustainably managed for all rangeland products</i></p> <p>2.3 Help meet energy resource needs</p> <p style="padding-left: 20px;"><i>Percentage of land Special Use Permit applications for energy-related facilities that are completed within prescribed timeframes</i></p> <p style="padding-left: 20px;"><i>Percentage of energy-mineral applications that are processed within prescribed timeframes</i></p> <p>2.4. Promote market-based conservation and stewardship of ecosystem services</p> <p style="padding-left: 20px;"><i>Number of states that have agreements with the Forest Service to help private forest landowners market ecosystem services</i></p>
<p><b>Conserve Open Space</b></p> <p>Maintain the environmental, social, and economic benefits of forests and grasslands by reducing and mitigating their</p>	<p>3.1 Protect forests and grasslands from conversion to other uses</p> <p style="padding-left: 20px;"><i>Acres of environmentally important forests and grasslands protected from conversion</i></p> <p>3.2 Help private landowners and communities maintain and manage their land as sustainable forests and grasslands</p>

Goal and Outcome	2007-2012 Objectives and Measures
conversion to other uses	<i>Acres of nonindustrial private forest land that are being managed sustainably under forest stewardship management plans</i>
<b>Sustain and Enhance Outdoor Recreation Opportunities</b>  A variety of high-quality outdoor recreational opportunities on the nation's forests and grasslands are available to the public	4.1 Improve the quality and availability of outdoor recreation experiences  <i>Percentage of recreation sites maintained to standard</i>  <i>Percentage of total recreation capacity at developed recreation sites that meets accessibility standards</i>  <i>Percentage of trails that meet national quality standards</i>  <i>Percentage of customers who are satisfied with recreational facilities, services, and settings</i>  <i>Percentage of road system intended for passenger-car use that is suitable for passenger-care use</i>  4.2 Secure legal entry to national forest lands and waters  <i>Percentage of high-priority access rights-of-way acquired</i>  4.3 Improve the management of off-highway vehicle use  <i>Percentage of NFS lands covered by new motor vehicle use maps reflecting a designated-use system of roads, trails, and areas</i>
<b>Maintain Basic Management Capabilities of the Forest Service</b>  Administrative facilities, information systems, and landownership management with the capacity to support a wide range of natural resource challenges	5.1 Improve accountability through effective strategic and land-management planning and efficient use of data and technology in resource management  <i>Percentage of selected data in information systems that is current to standard</i>  5.2 Improve the administration of national forest lands and facilities in support of the agency's mission  <i>Percentage of administrative facilities that are being maintained to standard</i>  <i>Percentage of newly reported encroachments and title claims administered to standard</i>
<b>Engage Urban America With Forest Service Programs</b>  Broader access by Americans to the long-term environmental, social, economic, and other types of benefits provided by the Forest Service	6.1 Promote conservation education to increase environmental literacy through partnerships with groups that benefit and educate urban populations  <i>Number of people who annually participate in Forest Service environmental literacy programs and activities</i>  6.2 Improve the management of urban and community forests to provide a wide range of public benefits  <i>Number of communities with developing or established urban and community forestry programs resulting from Forest Service assistance</i>
<b>Provide Science-Based Applications and Tools for Sustainable Natural Resources Management</b>  Management decisions are informed by the best available science-based knowledge and tools	7.1 Increase the use of applications and tools developed by Forest Service R&D stations and T&D centers  <i>Customer satisfaction with R&amp;D products and services</i>  <i>Number of patent applications filed, based on station and center discoveries, developments, and applications</i>

## APPENDIX E. NATIONAL FIRE AND AVIATION MANAGEMENT STRATEGIC PLAN GOALS AND OBJECTIVES

Goal	Actions
<p>Goal 1: Technology and Science (Fire and aviation management decisions are informed by the best available science and technology)</p>	<p>Annually prioritize, support, and select the research, development, and utilization of future technologies that assist fire management leaders in informed decision making</p> <p>Have a support system in place, including adequate training and hardware which readily transfers new technology to the field upon completion</p>
<p>Goal 2: Protection and Management (The nation's communities are protected and well-prepared for fire and the nation's resources are protected and managed through safe, efficient, effective wildland fire and aviation management and emergency response)</p>	<p>Manage wildland fires and emergency responses safely, efficiently and effectively as they occur</p> <p>Reduce the number of human-caused wildfires through prevention and education on an ongoing basis</p> <p>Land and resource management plans are developed to guide fire management and protection activities through desired conditions, objectives and guidelines</p>
<p>Goal 3: Hazardous Fuels and Restoration (Hazardous fuels are treated, using appropriate tools, to reduce the risk of wildland fire to communities and to the environment. Fire-adapted ecosystem are restored and maintained to achieve land management plan desired conditions, to mitigate and respond to the effects of a changing climate, and to achieve sustainable environmental, social, and economic benefits)</p>	<p>Within the context of a changing climate, prioritize and implement socially, economically, and ecologically sustainable management actions to reduce wildland fire risk to communities and natural resources</p> <p>Use fire or mechanical fuel treatments to create landscapes in which fire can be used to meet integrated resources management objectives and land management plan desired conditions for restoration, maintenance, and protection</p> <p>Capitalize on opportunities to derive economic benefits, recover treatment costs, or increase capacity to execute fuels treatment projects</p> <p>Hazardous fuels and other vegetation treatment objectives are achieved in an integrated fashion with a high degree of efficiency and effectiveness</p>
<p>Goal 4: Community Assistance (Communities in fire-adapted ecosystems are well-prepared for wildland fire)</p>	<p>Continue to assist communities in building capacity to prepare for, suppress, and reduce losses from wildland fires</p> <p>Reduce the number of human causes wildfires through prevention and education on an ongoing basis</p> <p>Provide assistance to our partners and cooperators in the wildland urban interface in accordance with mutual agreements</p> <p>Property owners and communities are fully engaged and proactive in mitigating impacts of wildland fire in the wildland urban interface</p> <p>Outreach to diverse and underserved communities at all levels of program delivery</p>
<p>Goal 5: Communications (The Fire and Aviation Management vision, direction, and expectations are understood, accepted, and supported internally, externally, and internationally, by stakeholders and cooperators)</p>	<p>Continually, leadership direction and expectations are clearly understood throughout the organization and are complementary with our cooperators</p> <p>Leadership, at all levels, delivers a clear, consistent message to the public regarding fire and aviation management programs and emerging strategies</p>
<p>Goal 6: Workforce (Fire and Aviation is a diverse, service-oriented, innovative, highly</p>	<p>Develop and maintain a professional wildland fire, fuels management, cooperative fire, and aviation workforce</p>

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<b>Goal</b>	<b>Actions</b>
skilled, accountable organization)	Continue to support a diverse workforce which reflects the American workforce Implement a performance management system that honors, values, encourages, and awards innovative thinking Develop metrics that define employee accountability in meeting their fire and aviation management

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## ATTACHMENT 4. DECISION-MAKING, VALUES, AND A SAFETY CULTURE FOR LARGE FIRES<sup>1</sup>

### 1.0 Introduction

A decision is a choice among alternative courses of action. Complicated situations typically engender difficult decisions because a decision maker (DM)<sup>2</sup> has many interrelated factors to consider. Decision analysts consider a good *decision* to be different from a good *outcome*. In the decision analysis context, a good decision has to do with *how* it is made, not with the final choice or outcome. According to Hammond et al. (1999), “The only way to learn to raise your odds of making good decisions is to learn to use a good decision-making process...”

From “Continuous Improvement in Decision-Making for Large Fire Management: 2009 Communication Guide,” March 14, 2009:

*“Because of the changing fire environment, large, complex fires are increasingly more life threatening to firefighters and the public and becoming more expensive.*

- *One-quarter of one percent (0.25% = 20 to 30 fires) of the fires each year are the costliest in terms of consuming fire management resources and costing about one-third of the Forest Service suppression budget.*
- *All the fire fatalities that occurred on Forest Service jurisdiction in 2008 occurred on large, long-duration fires compared to no fatalities on these types of fires in 2005.”*

The cost and safety associated with large wildland fires are outcomes of decisions. Section 2 of this report summarizes the concepts that comprise a good decision process. Such decisions do not necessarily seek maximum safety because the absolute maximization of safety may preclude other perspectives, such as overall cost or minimum needed capability. Instead, DMs should seek a balance among all the factors and one objective of this report is to describe a way to do this. An important aspect of decisions made by an organization is that they consistently reflect the organization’s values and goals. Section 2.5, herein, emphasizes the importance of this point in the context of a good decision process.

Having described a good decision process that reflects an organization’s values, Section 3 provides an assessment of how decision making associated with the 2008 large fires reflected the core or guiding values espoused by the Forest

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<sup>1</sup> This attachment was written by Michael V. Frank.

<sup>2</sup> DM in this document refers to *anyone* charged with making decisions.

Service. Section 3 also discusses, with several examples, the contradictory messages about guiding values being received by incident management team members.

Using an analogy from the nuclear industry, which is another large decentralized industry that has achieved an excellent safety record, Section 4 describes a strategy for promulgating and disseminating a uniform set of organizational values so that each individual understands, follows and makes decisions that reflect the overall agency's guiding values. This strategy is the establishment and maintenance of a safety culture. A safety culture is achieved by establishing a hierarchy of goals, principles, and desired behaviors. If principles are followed, then the agency's goals are achieved, and if individuals follow desired behaviors, then the principles will be followed. Section 4 suggests a set of principles and desired behaviors to support the agency's articulated guiding values of safety first and property protection second. Section 5 concludes this report with a summary of key messages in the context of risk-averse decision-making. Risk-averse decision-making is seen to be a healthy approach to safety and, if accompanied by a cogent decision strategy (as outlined in Section 2) will lead to cost-effective decisions.

## 2.0 Concepts and Definitions

### 2.1 Definitions

Webster's dictionary defines *safe* as (1) free from harm or risk; (2) secure from threat of danger, harm, or loss; and (3) affording safety from danger. The state of being safe has an absolute quality to it; that is, one is either safe or not. On the other hand, risk has many gradations depending on the severity of the loss, injury, danger, or hazard, and the probabilities of each.

A common dictionary definition of *hazard* is a "source of danger." A hazard is an inherent condition or characteristic of an environment. It is not the same as a risk. For example, a forest fire is a hazard to people in its vicinity because of its potential to inflict injury from fire, smoke, evacuations, and longer term environmental changes. The risk of injury depends on what is done about the hazard. For example, one could reduce risk of injury to fire fighters by simply not attempting to suppress the fire. However, this might increase the risk of injury and financial loss to members of the public because of fire damage, evacuations and environmental damage. Risk reflects the probability of the hazard manifesting itself and harming people, along with the severity of that harm.

Webster's dictionary gives the following definitions for *risk*: (1) the chance of injury, damage, or loss, (2) the degree of probability of loss. These definitions connote both a negative event (or state) as in loss, injury, or harm, and a probability or likelihood of that negative event (or state) occurring. One aspect missing from this dictionary definition is the notion of the severity of the danger or the amount of loss. The concept of amount of loss, danger, harm, or injury of an event is as fundamental to the definition of risk as the probability of the event.

In a simple example, a 1 percent chance of having to spend \$1 million to suppress a fire has a lower risk than a 1 percent chance of having to spend \$10 million. Both the amount of the potential loss and the probability of loss contribute to risk.

The term “decision attribute,” sometimes called decision criterion, is a measurable or calculable factor used in deciding which alternative to choose. For example, the decision attributes for large fire tactics might be safety level, suppression cost, cost of property burned, and mission success (e.g. the achievement of suppression consistent with the plan). Multiattribute decisions involve more than one attribute, and each alternative has an outcome associated with each attribute. Decision analysis is the field developed to help guide DMs through a cogent, rational method for choosing among alternative courses of action. Following this method increases a DM’s understanding of the interrelationships of attributes and alternatives. Although it does take time to go through the process, the high human, environmental and financial costs of large fires demands that this time be taken.

Throughout this report, the following definitions are used:

- Risk – the probability as a function of severity of harm, loss, cost, damage, injury, or other undesirable event;
- Risk management – a process of making decisions to maintain a desired level of risk. Risk management, therefore, is not a synonym for safety;
- Decisionmaking – a process of choosing among alternative courses of action (i.e. alternatives);
- Decision analysis – a logical method that aids in decisionmaking;

## 2.2 Risk and Uncertainty

Suppose that we are all omnipotent and omniscient beings. We know everything that has and will occur in the macroscopic (nonquantum) world. We can do whatever it takes to change events we would like to avoid. In this scenario, would there be risk?

The answer is no. If we were all-knowing and present everywhere all the time, we would be able to see all possible outcomes of all our possible decisions and actions. Risk arises from our inability to reliably predict the future. Decisions we make and actions we take involve risk because we do not know what will happen when we take them. Another way of saying this is that the future is uncertain and, as a result, any actions we take involve some risk. The notion that risk is inexorably tied to uncertainty is fundamental to understanding how to make good decisions.

Decisions about safety are important in high-consequence courses of action, which are those having a large potential for injury, property damage, or environmental damage. Decisions involving safety are rarely one-dimensional.



For example, when confronted with the potential for a large fire, a decisionmaker (DM) will want answers to many questions. A few examples are:

- What are all of my alternatives?
- What will they cost?
- What is the level of safety for each alternative?
- What is the likelihood that each alternative will succeed?
- What is the environmental effect of each alternative?

Good DMs do not implement changes on the simple basis of reducing the probability or amount of any one attribute. Good decisions include all attributes consistent with the Forest Service guiding values.

### **2.3 Uncertainty and Probability**

Probabilities are a mathematical measure of uncertainty. By convention, probabilities range from zero (no chance of happening) to one (certain to happen). The local weatherman assigns a chance to his prediction of rain because he does not know for sure if it will rain. In the north coastal region of San Diego County, it does not rain about 350 days a year. Weathermen get excited when rain is possible, and they give a probability such as 20 percent chance of rain tomorrow morning increasing to 50 percent by late afternoon.

In another example, Weather.com gives hour-by-hour probabilities to account for the constantly varying atmospheric conditions that might cause rain. Decision and risk analysts assign a probability to future events because of these types of uncertainty.

Sometimes it does not rain at all and sometimes it rains when not predicted. The weathermen, therefore, do not precisely know the probability of rain. The probability that they give is uncertain. Meteorologists use computer models to make predictions about the weather. However, these models are only approximate. They do not fully account for all of the factors, effects, and interrelationships that lead to tomorrow's weather. Furthermore, the inputs to these computer models rely on weather stations that are widely scattered and, therefore, represent only an approximate measure of the atmospheric conditions such as temperature and pressure. The way decision makers deal with the uncertainty in the probabilities is by using a range of probabilities or a probability distribution such as a normal distribution (the so-called "bell shaped curve").

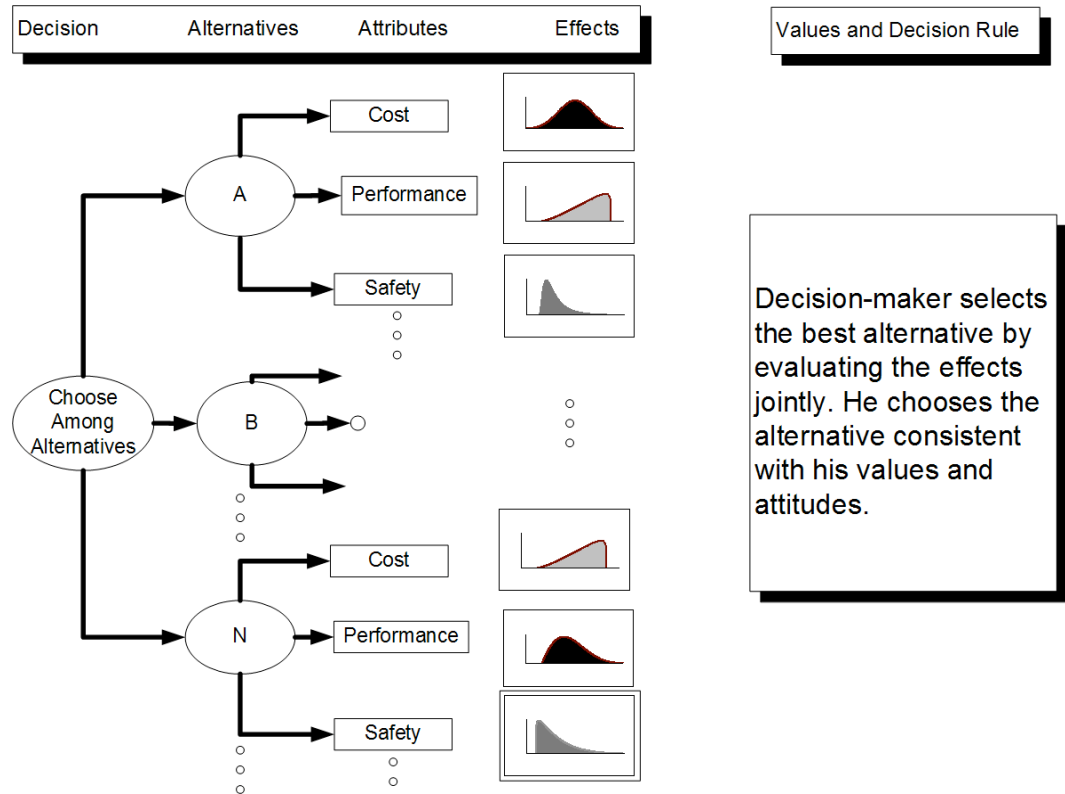
### **2.4 Safety as a Number in a Decision**

It has long been common practice among those who lead projects, organizations, or teams to calculate cost consequences of various alternatives. Safety is quantifiable and many analytical and empirical methods are available for doing

so.<sup>3</sup> If the level of safety can be quantified, then it can be quantitatively included in a decision-making process with the same rigor as other quantified attributes such as cost.

Figure 1 is a simplified graphic of the concept of safety-related decision-making. At the left of the figure is the point in time when a decision must be made (labeled “Choose Among Alternatives”). The figure shows three typical attributes – cost, performance, and safety.

**Figure 1. Overview of Safety-Related Decision-Making**



Source: Frank 2008

Probable effects (or consequences) of each alternative are estimated with respect to each attribute. The effects in Figure 1 are numerical quantities (the probability distributions), which yield a metric of each attribute. A good decision algorithm combines all the attribute consequences with the DM’s values (which should reflect the values of the organization) to arrive at a ranking of alternatives.

<sup>3</sup> See, for example, Frank, M.V. 2008. *Choosing Safety: A Guide to Using Probabilistic Risk Assessment and Decision Analysis in Complex, High Consequence Systems*. Washington D.C.: RFF Press.

## 2.5 The Role of Organizational Values or Goals

Still referring to Figure 1, the DM decides which alternative best meets the organizational objectives. Choosing the best set of effects involves combining consequences with values. As expressed by Keeney, “Values are principles used for evaluation. We use them to evaluate the actual or potential consequences...”<sup>4</sup>

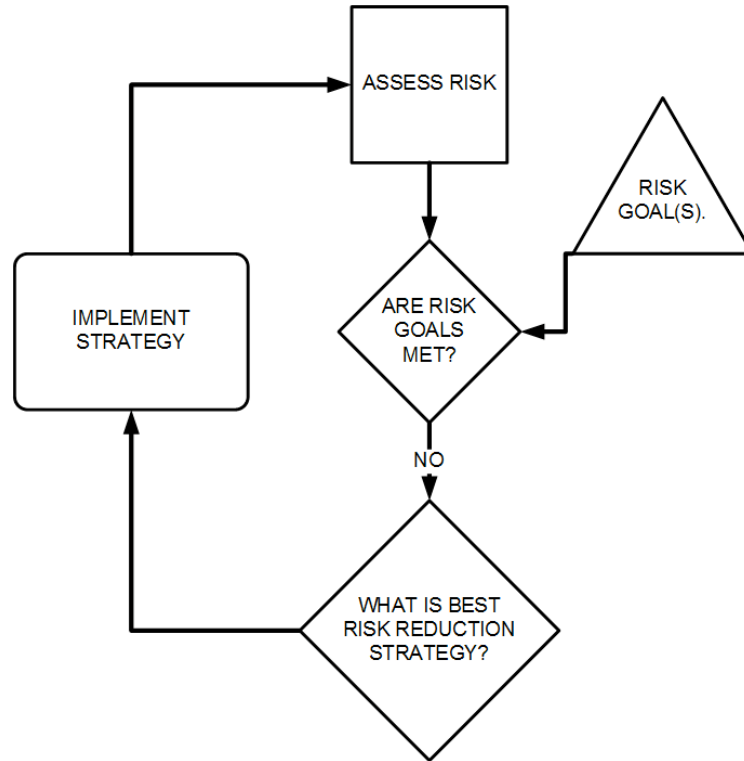
Without organizational values, the organization has no criteria with which to evaluate alternatives and make the best choices. The DM infuses the decision analysis with organizational values, allowing her to develop preferences among the attributes. For example, for purposes of fire suppression, she may value safety as much more important than cost or she may view them as equally important. Organizational goals and values should be her guide. The specific tools used to structure and execute a decision are less important than whether the tool is consistently applied across an organization in a manner obviously in concert with organizational goals and values.

Structuring a decision framework for large fires along the lines of Figure 1 means that the cost of fires is simply an uncertain effect (or consequence) of the process. It is not the only important attribute. Safety (and other performance measures such as environmental impact) is rightfully included in selection of the best alternative for fighting a large fire. Cost alone should not be the objective of a decision. Such a single-attribute decision trivializes the importance of the decision and excludes safety from being an important factor in selecting a fire control alternative. The 2009 Quadrennial Fire Review (QFR) reinforces this view in its statement: “Safety and risk management must be strengthened and more systematically incorporated into fire planning, developing safety metrics on a level equal with post-fire resource impacts and productivity.” The QFR also states: “Above everything is fire management’s commitment to safety and risk management.” Risk management, however, is not defined in that document. The definition of risk management (Section 2.1 of this report) implies that a goal (i.e. a desired level of risk) is specified, and means to measure whether or not the goal is being met are used. The notion of risk management is illustrated in Figure 2. Risk management is achieved by decisions that always have the goal in mind.

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<sup>4</sup> Keeney, R. 1992. *Value Focused Thinking*. Cambridge, MA: Harvard University Press.

**Figure 2. Notion of Risk Management**



Source: Frank 2008

## 3.0 An Assessment of Decision-making for Large Fires

### 3.1 Forest Service Values

The Forest Service Fire and Aviation Management web page<sup>5</sup> articulates the following overarching values: “Our core values of Safety, Integrity, and Mutual Respect guide our interactions, our decision-making, and our care of America's public lands.” Similarly, the Wildland Fire Policy web page states: “Protection of human life is the first priority in wildland fire management. Once firefighters are committed to an incident, they are the number one priority. Property and resource values are the second priority, with management decisions based on values to be protected.”<sup>6</sup> This priority was reinforced in the first two guiding

<sup>5</sup> U.S. Department of Agriculture, Forest Service. No Date. *Fire and Aviation Management*. Retrieved June 18, 2009, from <http://www.fs.fed.us/fire/>

<sup>6</sup> U.S. Department of Agriculture, Forest Service. No Date. “Wildland Fire Policy.” *Fire Management*. Retrieved June 18, 2009, from <http://www.fs.fed.us/fire/management/policy.html>

principles which are fundamental to successful implementation of the 2001 Federal Fire Policy:<sup>7</sup>

*“1. Firefighter and public safety is the first priority in every fire management activity.*

*2. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process. Federal agency land and resource management plans set the objectives for the use and desired future condition of the various public lands.”*

However, as is reflected in the Large Fire Cost Reviews,<sup>8</sup> suppression costs are a highly visible, significant, and growing concern when making decisions about controlling large fires. Interestingly, there appears to be no companion set of reviews for safety and this Panel is constituted to make a determination of suppression cost malfeasance – not safety, although on the average 20 lives are lost each year in suppressing large fires. The attitude of these reviews is critical of decisions that appear to engender higher than expected or higher than historically recorded costs for similar fires. Indeed, the costs of fires are routinely compared to a Stratified Cost Index. This index was developed from a systematic analysis of costs of fires and includes the uncertainty in costs for similar types of fires. This uncertainty is expressed as mean values and confidence intervals (i.e. probability distributions) so that the expenditures on new fires can be compared to the range of historical costs on similar fire types. The emphasis on cost reviews and cost metrics appears to represent a departure from, or an ambiguity to, the espoused value of “safety first” described above.

### **3.2 Contradictory Messages on Values**

Despite the stated overarching values, the emphasis on cost is undeniable and permeates the organization. Several insights developed in the documentation of 48 interviews with incident management team members support the thesis that the fire management personnel of the Forest Service are obtaining mixed and even contradictory messages about priorities.<sup>9</sup> As an example, from page 419:

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<sup>7</sup> U.S. Department of Agriculture, and U.S. Department of the Interior. 2003. *Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy*. June 20. Page 23. Retrieved June 18, 2009, from [http://www.nifc.gov/fire\\_policy/pdf/strategy.pdf](http://www.nifc.gov/fire_policy/pdf/strategy.pdf)

<sup>8</sup> See, for example, FY 2008 Pacific Southwest Region Large Fire Cost Review, February 12, 2009, Version 1.3; 2007 U. S. Forest Service & Department of Interior Large Wildfire Cost Review: Assessing Progress Towards An Integrated Risk and Cost Fire Management Strategy; A Report on 2007 Wildland Fires by the Independent Large Wildfire Cost Panel, Chartered by the U. S. Secretary of Agriculture, April 24, 2008.

<sup>9</sup> Canton-Thompson, J., K.M. Gebert, B. Thompson, G. Jones, D. Calkin, and G. Donovan. 2008. “External Human Factors in Incident Management Team Decisionmaking and Their Effect on Large Fire Suppression Expenditures.” *Journal of Forestry* 106 (8): 416-424.

*“Increasingly, teams are encountering agency administrators with little or no suppression background or experience with fire. Those interviewed stated that this can escalate costs because agency administrators without fire experience tend to be more risk averse and want to use more resources than perhaps necessary to avoid possible bad outcomes.”*

Risk aversion emerges because “of a perceived lack of agency support and an increased risk of personal liability if things go wrong.” (Page 418)

*“Not all agency administrators placed a low priority on costs, but even when they did focus on containing costs, it could ironically result in larger costs in the longer run, according to interviewees. They noted that some agency administrators are so committed to cost containment they order a type 2 instead of a type 1 team, regardless of complexity analysis, or they release teams too soon.” (Page 419)*

From page 420:

*“There’s no real performance measure of what cost containment is...It’s totally subjective on the part of the agency or person taking a look at it.”*

In contrast to the overarching Forest Service priorities of safety first and property value second, from pages 421 and 422:

*“The only thing that even came into my mind was the whole social-political aspect of it – that most of the things that make large fires costly are out of our control. It’s that original decision, and that expectation when it comes to protecting communities [is] we’re going to bring to bear all the resources we can get to do that; and cost doesn’t influence that. It doesn’t influence that original decision to do that. (Interviewee 15)”*

*“Virtually all team members interviewed explained that an increasing population in the WUI has exerted greater demands on suppression organizations.”*

*“Interviewees described how they receive political pressures to suppress fires “at all costs” while the fires are burning intensely. However, once the fire is over, they said they are subject to opposite political pressures. At that point, the rest of the country, including government oversight agencies, now want to know why so much money was spent and why more was not done to contain costs.”*

*“According to those interviewed, political considerations can often be the driving force behind some decisions made on large fires, ... politics pressured them to use resources, strategies, or tactics they would not normally have used and, which in many cases, they knew would be ineffective. Examples include marginally effective retardant drops on a fire smoking out a community or taking action to suppress interior*

*islands of fire posing negligible escape potential when upset community members harangue the agency administrator or their political representatives to “go put it out.” These political smokes often require aviation resources, which add greatly to an incident’s costs.”*

If safety of fire fighters were the highest priority, or at least a significant factor, then would the decisions to use unnecessary aviation resources and take unnecessary actions in rough terrain still be made? An emphasis on factors other than fire fighter safety (e.g. “political smokes,” “suppress fires at all costs” to protect property) is inconsistent with the stated agency values and is causing confusion in the minds of those who are responsible for controlling large fires. Similarly, an overemphasis on cost control is inconsistent with the Forest Service emphasis on safety. It also should be understood that the converse is true. An overemphasis on safety diminishes the effort on cost control. As described in Sections 2.4 and 2.5 of this report, both must be considered in an organized way when making decisions about large fires and decisions across the agency must consistently reflect the values of the Forest Service.

### **3.3 Disparity Between Agency Values and 2008 Large Fire Decisions**

Because of the number of large fires, the 2008 fire season presented an opportunity to assess how well the selection of fire management alternatives for large fires (as represented by Wildland Fire Situation Analysis (WFSA), Wildland Fire Decision Support System (WFDSS) and agency administrator statements) reflects Forest Service overarching values. An analysis of decisions involving 18 large wildfires in 2008 (as described in the 2008 Region 5 Large Fire Cost Review and a copy of the Gunbarrel fire WFSA) was performed from this perspective. This is not an evaluation of the specific decision tool used (WFSA, WFDSS etc.) or the effectiveness of a specific decision tool.<sup>10</sup> This was a higher-level survey and assessment of the main factors that governed the tactical decisions to select a specific alternative for managing large fires, and how those factors compare to the stated overarching Forest Service values of safety, property protection and resource value protection. The information compiled for each fire decision is shown in Appendix A, at the end of this attachment. As far as was available from the aforementioned information sources, the following factors were included for each identified alternative within each decision:

- Probability of Success (POS)
- Safety Rating
- Estimated Suppression Cost
- The Selected Alternative

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<sup>10</sup> The specific tools used to structure and execute a decision are less important than that the tool is consistently applied across an organization in a manner obviously in concert with the organization’s goals and values.



- Date of Decision
- Reason for Decision (from WFSAs or WFDSSs): Most Cost Effective; Least Suppression Cost; Safety; Least Acres Burned; High Value Targets Protected; Other<sup>11</sup>
- Agency Administrator Approval Date
- Agency Administrator Justification for selected alternative: Cost, Land Management, High Value Target Protected, Safety, Least Acres Burned, Other

The assessment produced the results shown in Table 1.

**Table 1. Results of Assessment**

Category	Number of Fires
Number of fires with multiple decisions	13 of 18
Number of fires with more than two decisions	5 of 18
Selected alternatives with less than highest POS	9 of 28
Selected alternatives with lowest suppression costs	13 of 30
Selected alternatives with highest safety rating	8 of 15
Selected alternatives with lowest safety rating	6 of 15
Decision made in favor of alternative with both lowest cost and highest safety	5 of 14
Selected alternatives in which justification in decision or agency administrator justification mentions safety	8 of 30
Number of alternatives in which safety > 5	27 of 37
Number of alternatives in which safety > 6	20 of 37
Number of decisions with POS < 60%	10 of 28
Number of decisions with POS =< 50%	9 of 28
Selected alternatives in which justification in decision or agency administrator justification mentions POS	3 of 28

Source: Frank 2008

Because of varying levels of detail and varying methods across the range of decisions, the sample sizes for each result differed. The sample sizes shown in Table 2 are relevant to these results.

<sup>11</sup> Other included: interjurisdictional cooperation, resource limitations, use of existing roads and natural features, most efficient with fewest resources, ecologically best, limit spread to other forests, season ending event anticipated.

**Table 2. Sample Sizes**

Category	Sample Size
Number of decisions with suppression costs	30
Number of decision in which all POSs provided	28
Number of decisions in which safety rating provided	15
Number of alternatives that contain a safety rating	37
Number of alternatives that contain both cost and safety ratings	36
Number of decision with both cost and safety	14
Number of Fires	18

Source: Frank 2008

A review of these results suggests the following overall observation:

*Tactical decision-making to select a large fire alternative (whether it be WFSA, WFDS, or other) does not appear to be strongly influenced by clear strategic guidance at the agency level. While the agency espouses the overall strategic values of making decisions that emphasize safety, cost-effective fire fighting, and development of success oriented alternatives,<sup>12</sup> local jurisdictions have not consistently applied these values when making tactical fire fighting decisions.*

Specific insights from the assessment support this overall observation:

1. *A minority of decisions cited suppression cost as an important criterion for deciding on a fire suppression alternative. Selection of the lowest suppression cost alternative was made in less than half of the sampled decision-making opportunities. Within 30 decision opportunities to choose the lowest suppression cost alternative for fighting a wildland fire, less than half exhibited such a selection.*
2. *A minority of decisions cited safety as an important criterion for deciding on a fire suppression alternative. Selection of the alternative with the lowest safety rating was made in approximately 40 percent of the sampled decision-making opportunities. Within 15 decision opportunities to choose the alternative for fighting a wildland fire with the highest safety rating, approximately half did so but 40 percent of the selected alternatives exhibited the lowest safety rating.*
3. *Low adherence to both suppression costs and safety as important criteria for deciding on a fire suppression alternative. Selection of the alternative with both the highest safety rating and lowest suppression cost was made in*

<sup>12</sup> See, for example, "Continuous Improvement in Decision-Making for Large Fire Management: 2009 Communication Guide", March 14, 2009: "The FS will focus on wildfire suppression decisions that can meet reasonable incident objectives using the safest and most cost-effective means that have a reasonable probability of success."

about one-third of the sampled decision-making opportunities. Similarly, within the statements in the reviewed material about justification of the selected alternative less than one-third mention safety. This is not caused by a lack of safe alternatives. More than half of the alternatives in which a safety rating was given have a rating greater than 6 of 10 and approximately three-quarters have a rating greater than 5 of 10.

4. *Low adherence to development of strategies with high probability of success.* Approximately one-third of the selected alternatives were rated with a probability of success of equal to or less than 50 percent and probability of success appeared to be an unimportant criterion in the justification of the selected alternatives.

#### **4.0 Propagation of Agency Values: A Culture of Safety for Large Fire Control**

The observance of an inconsistent and often contradictory application of stated strategic agency values in selecting fire fighting alternatives is supported by the above survey of decisions and interviews of incident management team members who receive mixed messages about these values. This strongly suggests an organizational disconnect between those who are vested with the responsibility of instituting organizational values and establishing strategic policy, and those who are charged with implementing the policy. This is a symptom associated with organizations that are decentralized in responsibility and have not yet been successful at instituting a uniformly adhered to culture. The Forest Service is not the only endeavor in which catastrophic events are possible and is not alone in espousing safety as its highest priority. Other industries, such as nuclear and aviation within which catastrophic consequences are possible, also espouse safety as their highest priority. In fact, these industries are also decentralized but have achieved noteworthy safety records, while maintaining a risk averse attitude. In both the nuclear and aviation industries a government organization is involved with establishment of policy and oversight over many private enterprises who implement the policies. In both industries, it has been found that establishment of a *safety culture* applied uniformly throughout and reaching top to bottom of all enterprises is a foundation of the excellent safety record. Of particular interest, is that in both industries achievement of a safety culture has been found to lead to more reliable and cost-effective operations because a safety culture leads to reductions in costly malfunctions and high consequence accidents.

In 1993, the Health and Safety Commission in the United Kingdom provided a useful definition of a safety culture:

*“The safety culture of an organization is the product of individual and group values, attitudes, competencies, and patterns of behaviors that determine the commitment to, and the style and proficiency of, an organization’s health and safety programmes. Organizations with a positive safety culture are characterized by communications founded on*

*mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures.”*

It is instructive to delve into the nuclear industry in more detail. The overarching goal of this industry is to achieve safe operation via a nuclear safety culture. From *Principles of a Strong Nuclear Safety Culture*:<sup>13</sup>

*“Safety culture: An organization’s values and behaviors – modeled by its leaders and internalized by its members – that serve to make nuclear safety the overriding priority.”*

Achievement of the culture is established by universal adherence to a set of principles as set forth in INPO, 2004 and reproduced below.

1. “Everyone is personally responsible for nuclear safety.
2. Leaders demonstrate commitment to safety.
3. Trust permeates the organization.
4. Decision-making reflects safety first.
5. Nuclear technology is recognized as special and unique.
6. A questioning attitude is cultivated.
7. Organizational learning is embraced.
8. Nuclear safety undergoes constant examination.”

The statement of principles, by itself, is not sufficient to assure a safety culture throughout this decentralized industry. A set of behaviors must also be developed and reinforced by training and procedures consistent with the principles. Peer pressure and reporting of infractions of procedures, training and principles are also key ingredients of a safety culture. It is important that self assessments and reporting of infractions are accomplished without prejudice or the threat of retaliation.<sup>14</sup> Each enterprise within the nuclear industry (e.g. the nuclear power plant owners and operators) is responsible for instituting the means to achieve a safety culture and auditing its own progress. Two entities evaluate and audit these enterprises: the Nuclear Regulatory Commission, which is a government agency and the Institute for Nuclear Power Operations, which is funded by the private sector. Each enterprise within the industry is free to use different tools, different decision-making methods, different management methods and different organizational structures. Of particular relevance, there is not a decision tool that each private enterprise uses to achieve safe operation. It is the sum total of behaviors that adhere to the principles of nuclear safety that

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<sup>13</sup> Institute for Nuclear Power Operations. 2004. *Principles for a Strong Nuclear Safety Culture*. November. Retrieved June 18, 2009, from [http://www.nrc.gov/about-nrc/regulatory/enforcement/INPO\\_PrinciplesSafetyCulture.pdf](http://www.nrc.gov/about-nrc/regulatory/enforcement/INPO_PrinciplesSafetyCulture.pdf)

<sup>14</sup> Detailed discussion of means to achieve such behaviors is beyond the scope of this report.

causes safe operation. A tool can not be a substitute for the culture of safety that permeates an industry.

Let's investigate how the lessons from the nuclear industry can be applied at a strategic level in the Forest Service for large fire control, assuming that safety continues to be the highest strategic priority followed by cost-effective operation. Table 3 lists suggestions for a set of Forest Service Principles for Large Fire Control in a manner analogous to the nuclear safety principles and then provides examples of behaviors that, if practiced by everyone in the Forest Service, would greatly contribute to the achievement of the safety culture for large fires.

**Table 3. Suggested Forest Service Principles for Large Fire Control**

<b>Suggestion for Forest Service Principles for Large Fire Control</b>	<b>Example Desired Behaviors</b>
1. Everyone is personally responsible for large fire safety and cost.	<ul style="list-style-type: none"> <li>a) The line of authority and responsibility for large fire safety and cost is clearly defined for all levels from the agency director to the individual contributor.</li> <li>b) Each of these positions has a clearly defined role, responsibility, and authority, designated in writing and understood by the incumbent when personnel change.</li> <li>c) Reporting relationships, positional authority, staffing, and financial resources support large fire safety responsibilities.</li> <li>d) The system of rewards and sanctions is aligned with strong fire safety procedures, fiscal diligence, and training which reinforces the desired behaviors and outcomes.</li> </ul>
2. Leaders demonstrate commitment to safety and cost.	<ul style="list-style-type: none"> <li>a) Leaders (e.g. agency directors, deputy directors, senior agency administrators, incident commanders) advocate for safety and consistently demonstrate their commitment in their decisions to safety, with an eye on costs.</li> <li>b) Leaders consider the perspective of the individual contributors (e.g. line fire fighters) in understanding and analyzing safety and cost issues.</li> <li>c) Selection and evaluation of leaders considers their abilities to contribute to a strong large fire safety culture.</li> </ul>

<b>Suggestion for Forest Service Principles for Large Fire Control</b>	<b>Example Desired Behaviors</b>
3. Trust permeates the organization.	<p>a) People are treated with dignity and respect.</p> <p>b) Personnel can raise concerns without fear of retribution and have confidence their concerns will be addressed.</p> <p>c) Personnel are expected and encouraged to offer innovative ideas to help solve problems.</p> <p>d) There is a free flow of information in which issues are raised and addressed.</p>
4. Decision-making reflects safety first and cost second.	<p>a) Preparatory development of scenarios for which tactical fire containment alternatives are developed in an unhurried atmosphere shall be encouraged.</p> <p>a) Personnel are systematic and rigorous in making decisions that support large fire cost-effective safety practices.</p> <p>b) When faced with unexpected or uncertain conditions, decisions should consider personnel safety first.</p> <p>c) When previous decisions are called into question by new facts, the decisions and associated underlying assumptions are reviewed to improve the quality of future decisions.</p>
5. Fire fighting is recognized as a science.	<p>a) Better ways to understand and contain large fires are continuously sought.</p> <p>b) Equipment safety improvement is sought and equipment is meticulously maintained and operated well within design tolerances.</p>
6. A questioning attitude is cultivated.	<p>a) While personnel should expect, and strive for, successful fire control, they recognize the possibility of mistakes and worst-case scenarios. Contingencies are developed to deal with these possibilities as a part of preparatory work.</p> <p>b) Opposing views are encouraged and given respectful consideration.</p>
7. Organizational learning is embraced to improve safety in a cost-effective manner.	<p>a) Training, self-assessments, corrective action programs, and benchmarking against other industries are used to stimulate learning and improve cost-effective safety practices.</p> <p>b) Large fire safety and cost are kept under</p>

Suggestion for Forest Service Principles for Large Fire Control	Example Desired Behaviors
	scrutiny through a variety of monitoring techniques, some of which provide an independent perspective.

## 5.0 Concluding Observations

Cost-effective operation with the highest priority on safety are the articulated Forest Service key values for large fire control. Unfortunately, these values were neither reflected in the selection of alternatives for fighting large fires in 2008, nor were they clearly and uniformly understood by agency and incident management team staff who are vested with the responsibility and accountability for large fire control. The emphasis on cost reviews and cost metrics appears to represent a departure from, or an ambiguity to, the espoused value of safety first for large fires.

Incident management team members are receiving mixed messages. On the one hand, some teams are subjected to the philosophy that cost control should dominate decisions; on the other hand, some teams are subjected to the philosophy that no cost should be spared to avoid a potentially catastrophic incident. A survey and assessment of the key factors that influenced selections of alternatives to control Region 5 large fires in 2008 (see Section 3.3 of this report) found that generally there is a large disparity between agency values and large fire decisions. Specifically, there was low adherence to both suppression costs and safety as important criteria for deciding on fire suppression alternatives.

Among interviewed incident management team members, there is confusion about the merit of being a risk averse DM.<sup>15</sup> A risk averse DM is one who is willing to spend more money than the expected value of a chance to lose money in order to avoid the possibility of a much larger loss. Most DMs who have to select among alternatives that involve safety are risk averse. They will spend more money than the expected value of a loss in order to lower the number of injuries and fatalities. The entire insurance industry is based on the notion that the population as a whole is risk averse. That is, the cumulative effect of risk averse behavior in a population is that, in order to save themselves from catastrophic loss, premiums will be paid that exceed the expected loss of insurers. It is prudent and natural, therefore, to be a risk averse DM when it comes to safety.

This does not mean, however, that DMs should simply abandon attempts at cost effectiveness. Section 2 of this report describes, at a strategic level, a cogent

<sup>15</sup> Canton-Thompson, J., K.M. Gebert, B. Thompson, G. Jones, D. Calkin, and G. Donovan. 2008. "External Human Factors in Incident Management Team Decisionmaking and Their Effect on Large Fire Suppression Expenditures." *Journal of Forestry* 106 (8): 416-424.



decision process that includes both cost and safety as key decision attributes and also includes uncertainties. Adherence to the principles and behaviors of a safety culture at all levels of the Forest Service, which supports its guiding values, is a prudent path toward a healthy risk averse approach to safety during large fires. Following the decision-making strategy outlined in Section 2 will point this behavior toward cost-effective decisions as well.

## **APPENDIX A: Survey and Assessment of Decisions in Eighteen Large Fires of 2008**

Fire	Deviation No.	Alternative	Probability of Success	Selected Alternative	Estimated Suppression Cost	Safety	Date	Moat Cost Estimate	Reasons for Selected Alternative				Agency Administrator Justification					
									Least Suppression Cost	Safety	Least Acres Burned	High Value Targets Protection	Other	Date Approved	Cost	Land Management	High Value Targets Protection	Safety
American River Complex	2	A	61%	NA	6.5	6.0	6/29/2008											
		B	44%	NA	8.09	5.6	6/26/2008											
		C	73%	A	21	6.0	7/10/2008	X	X	X								
Basin Complex	1	A	5%	55	7.4	6/26/2008	X											
		B	70%	B	67.5													
		C	33%	B	3.62	8.0	6/22/2008											
Cub Complex	2	A	72%	B	9.79	7.0	6/22/2008											
		B	33%	B	3.62	8.0	6/22/2008											
		C	73%	B	14.1	7.0	7/15/2008											
Indian Fire	1	A	80%	A	4.3	7.0	6/8/2008											
		B	90%	A	4.2	4.2	6/12/2008	X	X	X								
		C	70%	B	51.7	6.0	6/12/2008											
Iron/Alps	1	A	2%	1.52		6/21/2008												
		B	22%	B	6.15		6/26/2008	X	X	X								
		C	40%	B	51.7													
Sudross Complex	1	A	40%	A	9.16	10	6/21/2008											
		B	50%	A	20.28			X	X	X								
		C	42%	C	21.84		7/7/08											
Blue Creek Fire	1	A	80%	A	0.18		6/23/2008	X	X	X								
		B	70%	A	2.73													
		C	80%	A	0.72		6/23/2008	X	X	X								
Siskiyou/Blue 2	3	A	7%	B	65.00		7/13/2008	X										
		B	38%	B	74.50													
		C	5%	B	13.35		6/10/2008	X										
Thomson Bear Complex	1	A	49%	A	49.66		7/26/2008	X	X	X								
		B	83%	A	84.41													
		C	63%	A	30.00		7/27/2008	X										
Bear Fire	1	A	10%	B	2.60		7/24/2008	X										
		B	80%	B	19.08													
		C	2%	C	4.50		6/21/2008											
Liner Complex	2	A	23%	C	6.20	9	6/22/2008	X										
		B	7%	B	13.30	3.3	6/22/2008											
		C	23%	B	11.20	2.2	6/22/2008											
North Mountain Fire	1	A	50%	A	1.58	4.2	6/23/2008	X	X	X								
		B	60%	A	1.60	4.2		X	X	X								
		C	73%	A	11.10	4.0												
Pure Fire	1	A	70%	B	1.50	9.0	6/29/2008											
		B	52%	B	1.50	7.0												
		C	23%	B	6.8	7.0	6/30/2008											
Rah Fire	1	A	90%	B	9.9	7.3	7/8/2008											
		B	50%	B	5.3	7.3												
		C	73%	B	14.9	7.0	7/30/2008	X										
Sudra Complex	1	A	70	A	7.2	2.3	6/27/2008	X	X	X								
		B	40	A	26.5	1.7	7/19/2008											
		C	40	A	26.2	6.0												
Gambarel	1	A	NA	C	6	6.6	8/24/2008	X										
		B	NA	C	5	7.9												
		C	NA	C	6.3	7.4												

# ATTACHMENT 5: IMPROVED REVIEW AND FOLLOW-UP PROCESS<sup>1</sup>

## Introduction

Performance reviews can be critical management tools. They identify emerging needs, drive accountability and reinforce organizational change – including the adoption of new tools and best practices. An effective review starts with clear review objectives. It concludes with follow-through that evaluates whether corrective actions have been implemented, and if so, whether these effectively improve the organization.

Currently, the high number of cost and performance reviews results in review fatigue. This is a strong force against rigorous analytical insights and corrective actions when warranted. In practice, fire reviews do not follow a complete set of standard practices. These factors contribute to a lack of useful organizational change resulting from reviews.

We recommend changing the review process to decrease the number of reviews and increase the relevance, usefulness and effectiveness of those cost and performance reviews that are conducted. The recommended process follows six steps:

1. **Define a unique review scope** – Managers define the unique scope and objectives of each review.
2. **Explain findings in context** – Reviewers explain the importance of findings in context of a desired outcome.
3. **Propose specific recommendations** – Reviewers engage managers to develop specific recommendations linked to findings.
4. **Develop an action plan** – Managers develop a prioritized set of actions to address recommendations and lead to desired results.
5. **Track implementation** – Managers drive and track implementation of actions, and reviewers perform follow-up audits and evaluate the results of implemented actions.
6. **Incentivize implementation** – Managers include implementation of actions and recommendations in forest and individual performance objectives.

## Methods and Observations

We reviewed guidance and scope documentation for large fire cost independent panel reports, regional large fire cost reviews and Quadrennial Fire Reviews

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<sup>1</sup> This attachment was written by Jeremy Sokulsky and Maria Mircheva.

(QFRs). We reviewed the 2005-2007 independent panel reports, regional reviews from 2008 and the two most recent QFRs to familiarize ourselves with the content and format of the findings and recommendations in these reports. The panel also summarized findings and recommendations from these reports. The panel conducted interviews with past reviewers and Forest Service personnel to determine how current review procedures are being conducted, the degree to which review findings are used, and what follow-up was performed on those reviews. Samples of internal reviews were evaluated including: the Chief's Principal Representative Review, Regional Forester Review, After Action Review, Finance Review, and Cost Review.

Repetition of review recommendations, over time and across different reviews, indicates that review scopes overlap and recommendations are not driving organizational change (see Attachment 3). This was reinforced by interviews with current Forest Service staff who described issues we categorize as review fatigue.

## Proposed Review Process

The following describes the steps of the recommended review process along with observations related to how it may differ from current practices.

### Step 1: Define a unique review scope

Clearly-defined review scope and objectives enable reviewers to focus on specific priority issues. Having clearly-defined scope and objectives for each review also facilitates the identification of review overlap. Forest Service management, select Regional Offices, and individual forests should perform an inventory of the reviews performed to evaluate the scope of each review and to determine the value added by each review. In order to increase efficiency, review scopes and procedures should be redefined and some reviews may be eliminated. For more-detailed discussion and a proposed scoping model, refer to Attachment 3.

The scopes of current reviews often overlap with each other. This is likely to result in inefficient use of resources and also contributes to review fatigue. For example, the large fire cost reviews cover major fires within a region costing over \$5 million, and those over \$10 million are reviewed again in the independent panel review. The objectives of both types of reviews are to determine whether resources were used appropriately, and to identify ways to increase the effectiveness and efficiency of future wildland fire suppression efforts. Both reviews are performed, by 5-member teams, a few months after the fire incidents. This results in review findings being similar in content across these two types of reviews.

In summary: an evaluation of the full set of existing reviews should be performed in an effort to minimize the redundancy of objectives between reviews, and eliminate unnecessary overlap between reviews. Further, managers should identify a unique scope and clear objectives for each review.

## Step 2: Explain findings in context

Clear findings, supported by evidence, and described in the context of a desired state, facilitate comprehension and action. Reviewers should base their findings on specific data and indicate how the current state of affairs differs from the desired state.

Past review findings are frequently general, do not cite specific supporting data, and are not presented in context of a defined desired state. For example, the Regional Large Cost Fire Reviews for Regions 1, 2, and 6 answered the questions in the regional review guidebook, but frequently did not formulate clear findings supported by evidence in context of a desired state. Below is an example from Part A of the Region 2 Large Cost Fire Review:

### *Region 2 2008 Review, Finding A2*

*“The viability and use of the stratified cost index (SCI) are not well understood by fire managers and agency administrators at this time. Nor is it understood if the fires used to calculate the SCI are of a nature that makes them viable for a comparison to a fire like Gunbarrel.”*

The evidence for this finding is not provided in the review. Perhaps the information was gathered through interviews or it was assumed from the lack of SCI use. Presumably, the desired state would be for fire managers and agency administrators to understand how to use the SCI, but the benefits of acquiring that knowledge are not stated. Further, the finding is not linked to a recommendation on how to increase forest expertise and SCI use.

In summary: reviewers should (1) cite specific data that supports findings, (2) present findings in the context of a desired state, and (3) link findings to recommendations.

## Step 3: Propose specific recommendations

Clear recommendations, linked to findings and developed with input from the managers responsible for implementing them, are relevant and actionable. While reviewers are experts in their fields, they do not always understand the intricacies of individual forest operations and cannot always describe what specific actions should be taken to remedy a situation. The reviewer and the reviewed party should work collaboratively to develop specific recommendations to address findings, including details regarding who is responsible for overseeing implementation.

Of the five regional fire reviews analyzed from 2008, three did not have their recommendations linked to findings. Further, recommendations are frequently not sufficiently clear and specific enough to be actionable.

Below are two examples from Regional Large Cost Fire Reviews:

### *Region 1 2008 Review, Recommendation 2*

*“Evaluate the approach of providing incident strategy to agency*

*administrators in segments to allow for choice. Share the process with other IMTs if it contributes to better decision-making and a reduction of costs."*

This may be a sound recommendation, however it is less likely to be implemented and cause organizational improvements because: the context for this recommendation is not provided in the report; it is not clearly linked to a finding or desired state; and no responsible party is identified to oversee its implementation.

***Region 1 2008 Review, Recommendation 5***

*"Continue to provide outstanding leadership in cost apportionment agreements."*

This is a good statement of a theme, but it is not specific and actionable. The context of this recommendation is not defined in the report, nor is the party responsible for overseeing implementation of the recommendation.

In summary: reviewers and line officers and incident commanders should work collaboratively to develop clear recommendations that are based on findings and lead to actions. These recommendations should be sufficiently clear and specific as to lend themselves to translation into action. The appropriate mechanism for recommendation implementation oversight should be identified.

#### **Step 4: Develop an action plan**

Broad recommendations are implemented through concrete actions taken by specific individuals and groups. Review reports must spur immediate actions—including evaluation of report findings, and creation and prioritization of an action list—in order to be effective in improving fire suppression efforts. Once a review is performed, the appropriate level of management should respond to each recommendation with an evaluation of its importance in the context of organizational goals and a proposed set of actions. Actions should define performance criteria that will enable evaluation of the effectiveness of actions taken.

Requiring responses to reviews will motivate implementers to outline and track the actions they take in response to review recommendations. While regional reviews require responses within one year, independent panel reviews do not seem to require formal follow-up. Jim Hubbard's 2008 LFCR letter indicates that responses to regional review recommendations are frequently late. Region 1 exemplifies a best practice by ensuring responses to large-fire reviews are developed and sent with the subsequent year's review.

Even when responses are required, it is unclear whether the responses are adequate. Responses describe what actions have been taken in the past year related to a recommendation, but do not necessarily describe whether the actions achieved the desired result.



Below are our comments on the first two recommendation responses from the Region 1 2007 Large Cost Fire Review:

“Recommendation 1: Develop a monitoring plan and process to determine the value and effectiveness of the Long Term Implementation Plans (LTIPs) and decision-support tools (SCI, RAVAR, FSPro, etc). We want to build on our identified successes and utilize LTIPs as a WFSA validation/review tool.”

“Response: LTIPs are now incorporated into the WFDSS process.”

The response describes an action that addresses the second part of the recommendation, but not the first part. There is no mention of a monitoring plan or the effectiveness of decision-support tools. It is unclear how incorporating LTIPs into WFDSS led to the desired result.

“Recommendation 2: Define and understand the Forest Service roles and responsibilities for structure protection. This will also aid in interagency and public understanding.”

“Response: Region 1 continues to work with our interagency partners to develop an understanding of roles and responsibilities for structure protection activities. This topic was the subject of an exercise conducted at the 2009 Line Officer Wildland Fire Decision Support System workshops.”

This response describes a clear action implemented to address the recommendation. However, without the context of a complete action plan, it is unclear how the workshop exercise relates to achieving the desired state, if the workshop effectively addressed the recommendation, or if the recommendation is near being addressed.

In summary: actions should be developed to implement recommendations. These actions should include defined performance criteria. The performance criteria should then be used to evaluate the effectiveness of the actions taken. Responses to reviews should be required. These responses should describe the action implemented in response to the recommendation and specify whether the action achieved the desired result.

### **Step 5: Track implementation**

Follow up on recommendations and action plans is critical in order to emphasize the importance of addressing review recommendations and in order to motivate change within the organization. To follow up on review recommendations, independent checks should be performed annually to verify that agreed-upon actions are effectively executed. In addition, reviewers should assess whether implemented actions are leading to desired outcomes. Review recommendations and related actions should be tracked by: priority, status, responsible party, due date and days outstanding beyond the due date. A simple recommendation and actions tracking table may suffice. However, a system to track review findings implemented at each level of management – national, regional and forest –

would facilitate inclusion of recommendation follow-up information in personal, forest, regional and overall organizational performance reviews.

Currently, tracking of recommendations, follow-up actions and results is inadequate. Jim Hubbard's 2008 LCFR letter indicates that the Forest Service is starting to track whether regional review recommendations have been implemented. However, it is unclear if other review recommendations (from independent panel, QFR, and internal reviews) are being tracked. In addition, no standards are currently in place to determine if a recommendation has been implemented and whether the desired results were achieved.

In summary: the parties responsible for implementing recommendations should track and report on completed actions. Independent checks should assess whether actions are effectively implemented. Reviewers should assess whether implemented actions are leading to desired outcomes.

### **Step 6: Incentivize implementation**

Top management must express commitment to implementing review recommendations in order for the review recommendations to drive action and change. Including review follow-up metrics in personnel performance reviews clearly sends the signal that implementing review recommendations is an organizational priority. Management should define responsible parties to implement actions. The level of follow-up on those actions should be reflected in individual and overall forest annual performance reviews.

Currently, follow-up on review recommendations is not a part of forest objectives or personnel performance reviews. Thus, there is a lack of incentive to follow-up on and implement review recommendations in a timely manner.

In summary: personnel performance reviews should include metrics to evaluate implementation of actions. A summary of follow-through at the forest level should be created and provided to reviewers for their evaluation of recommendation follow-through and effectiveness.

## Illustrative Example of the Recommended Review Process

The intent of the recommended review process is to improve the rigor of reviews and to facilitate organizational change. The review process is illustrated with one of the 2008 Independent Panel Review findings. This is an example, and describes a hypothetical management response and follow-up in order to illustrate the recommended review process.

### Step 1: Define a unique review scope

The Independent Large Fire Cost Review has a defined scope, which includes a request to review resource allocation models and criteria utilized. The following finding relates to this and other focus areas identified in the scope.

### Step 2: Explain findings in context

*Finding: Delegation of Authority letters (DOAs) do not give IMTs specific guidance about costs. Of the 5 DOAs reviewed for fires with suppression costs over \$10 million in 2008, only the Gnarl DOA letter had a budget assigned to the IMTs. The rest of the letters included a general reference to cost containment but no specific guidance. While IMTs take costs into consideration, they are not held accountable to a budget, leaving the door open for over-spending.*

(This finding is presented in the context of using DOAs to define cost parameters to be considered in fire suppression strategic and tactical decisions in order to reduce fire suppression costs.)

### Step 3: Propose specific recommendations

*Recommendation: Upon delegating authority to the IMTs, agency administrators should develop a budget collaboratively with IMTs and include it in the DOA letter. The AAs and IMTs will review and update the budget daily. Cost over-runs will be recorded and analyzed.*

(This is a hypothetical recommendation. If it were in the scope of the review, we would ideally review this recommendation with AAs and IMT incident commanders to refine it and ensure it is actionable and specific.)

### Step 4: Develop an action plan

In response to this recommendation, managers develop a prioritized set of actions to address recommendations and lead to desired results. Hypothetically, these could include:

- First, the Washington Office determines how this finding links with expected outcomes (in this case improved cost-effectiveness) and how important it is with respect to other agency priorities.
- Second, the Washington Office determines how budgeting for individual fires can be achieved and provides direction through the issuance of guidance regarding including cost guidance in DOAs, and allocating resources to develop training modules, and have NIMO teams train AAs and IMTs.
- Third, the NIMO teams commission development of a cost training module and add it to their pre-season training work with AAs and IMTs.

### Step 5: Track implementation

This recommendation and related actions are tracked in a follow-up tracking table by responsible party (Washington Office, NIMO teams, Forest Supervisors), due date, and performance measures (% of agency administrators trained, percent DOAs issued with budgets). The 2010 and subsequent independent review panels could check the degree and pace of implementation of these actions and evaluate if they are leading to the desired state of reducing fire suppression costs.

### Step 6: Incentivize implementation

Attending budgeting training, and issuing DOAs with cost guidance, are established objectives for AAs of forests with a high likelihood of experiencing large fires. Accurate fire incident budgeting and staying within the fire budget can be included in forest objectives.