

**2007 U. S. Forest Service & Department of Interior
Large Wildfire Cost Review**

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**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

The Panel's work was managed under a contract with the Brookings Institution.

**The Panel is an independent undertaking.
The views expressed herein are solely those of its members**

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The report is solely attributed to the Panel members. The analysis and views expressed in this document are solely those of its authors and members, and do not reflect the views of the Brookings Institution, its Trustees or its research staff.

Executive Summary

In terms of scale, the 2007 fire season was second only to last year in acres burned and costs expended. In 2007, there were 27 fires costing over \$10 million whose total suppression cost approached \$547 million, exclusive of burned area emergency rehabilitation costs. These fires alone accounted for just less than 3 million burned acres. All wildfire acres reported to the National Interagency Coordination Center in calendar year 2007 totaled 9.32 million acres at a federal cost of nearly \$1.8 billion.

This report by an Independent Review Panel examines wildfire incidents during Fiscal Year 2007 that exceed \$10 million in cost. The Panel's purpose was to: "determine if the Forest Service exercised fiscal diligence in managing specific incident suppressing activities." The 27 fires in this year's review occurred in six regions and included 23 fires managed by US Forest Service and four by Department of Interior agencies. The objectives the Panel was asked to focus on were strategic decisions and actions, compliance with policy and law, and risk analysis and management. The Panel was also tasked with several supplemental objectives, and asked to gauge the degree of progress towards the larger goal of cost containment in fire management.

The Panel, through field visits to the regional offices, conducted either face-to-face or video or phone half day interviews with each of the Forests and Department of Interior units where the fires occurred. These interview reviews covered strategic discussions of pre-fire conditions, fire chronology information, fire planning, suppression actions and results, and an assessment of cost management and fire outcomes.

As the report notes, the Panel unanimously decided that no unit or its fire staff exercised unacceptable fiscal diligence. The Panel noted that there were fire situational strategic and tactical decisions that were not universally accepted by all the participants on fires. The Panel sometimes questioned suppression strategies as potentially being overly conservative or highly risk adverse. But these positions and actions were not viewed as indicating fiscal malfeasance.

The sense of the Panel was that in 2007 there was much greater awareness of cost containment throughout the fire community. From local fire staffs to incident commanders to line officers and regional staff and directors, there was a concerted effort to make cost management more than just another competing priority. This is further reflected in an increase in the use of suppression strategies other than direct attack or full perimeter control.

The Panel's report also compared the 27 wildfires in the 2007 review with the 18 wildfires from the review of the 2006 Large Fire Panel. While both fire years are somewhat similar, there are some notable differences in fire management, choice of suppression strategies, and resourcing, especially on longer term fires. This comparison found positive movement in incorporating cost containment as a factor in the choice of

suppression tactics, the selection of incident teams, and the use of resources in lowering the potential cost of fires. This was most apparent in long term fires—those fires that remained outside of local control for more than 42 days.

The Panel recognized that these cost management efforts often lack transparency at higher strategic levels and that much more needs to be done to understand the full implications of fire cost, suppression strategies and tactics, and incident outcomes.

Other findings in this year’s review concerned progress made in implementing previous recommendations. These included the following:

- a. Land management and fire management plans still appear quite static and unresponsive to increasing levels of fire activity. But there may be a future opportunity to collaborate more closely with the increasing number of neighboring jurisdictions next to federal lands that are developing community wildfire protection plans (CWPP).
- b. The Wildfire Situational Analysis (WFSAs) process was more effective this year, compared to last year, in that it was ahead of the fire size. Most of these fires used long term management plans with new decision support tools (FSPRO and RAVAR). While results were divided, there is commitment to bringing in the next generation of strategic assessment systems.
- c. There were greater levels of flexibility in the choice of incident management teams. This was especially the case in developing an extended cost strategy for longer fire events, managing complex fires, and using high cost resources; (i.e., aviation assets).

The Panel was also given additional evaluation objectives that included assessing progress made in transitioning to risk-informed management, achieving centralized management of national shared resources and aviation assets, using severity and other evaluation tools, including the Stratified Cost Index (SCI) and regional reviews. Conclusions were encouraging but mixed. While the Panel was not able to conduct a systematic evaluation of all the supplemental objectives, it derived some findings in these areas and developed recommendations for continued improvement.

Supplemental tables comparing the 27 fires on these issues are included. These served as the basis for the Panel’s findings. Two additional appendices are added to the report. The first advocates considering a more agile and flexible resource planning and ordering strategy, along the lines of what the military has done over the past five years. The second includes a more comprehensive appraisal of the different reviews currently being used to assess cost containment by the regions and the federal fire community. It suggests how these reviews might be a more valuable source of organizational intelligence.

Summary of Panel Recommendations

Land Management & Fire Management Plans

- **Recognize the goal of transforming Fire Management Plans (FMPs) from static, program reference documents to more strategic assessments of fire management planning and policies, and develop a more selective approach to FMP revision.**
It is important to have dynamic, integrative, and collaborative FMPs, rather than simply static updated versions.
- **Continue expanding Appropriate Management Response (AMR) guidance in FMPs with an aim to increasing “transparency” on the range of suppression tactics and alternatives.**
AMR will only be successful if it is understandable to public and neighboring partners, and there are consistent definitions across the Forest Service regions and the five federal agencies
- **Create a stronger linkage from FMPs to Community Wildfire Protection Plans (CWPP) by creating a more collaborative approach for fire prevention planning than exists now.**
Promote opportunities and means among federal units and their neighboring communities for sharing annual FMP updates and CWPP reviews in order to engage the wider community in fire management.

Wildland Fire Situational Analysis and Decision Support Tools

- **Ensure that the next generation of decisional support processes for predicting fire risk and potential fire size learns from the WFSA process.**
The next generation of decision support tools for fire risk management must address multiple fire strategies in complex management and longer-term fire scenarios. These tools will enhance collaboration and incorporate cost management as a critical value in decision analysis.

Incident Management Team Staffing & Resourcing

- **Continue to pursue more flexible suppression strategies, especially on extended fires, and encourage more strategic staffing and resource levels..**
As the fire management process continues to improve its ability to manage fire suppression assets and resources in a risk and cost sensitive context, it should seek to tackle the supply side of the fire management equation.

Reviews, Reports and Outcome Metrics

- **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.**

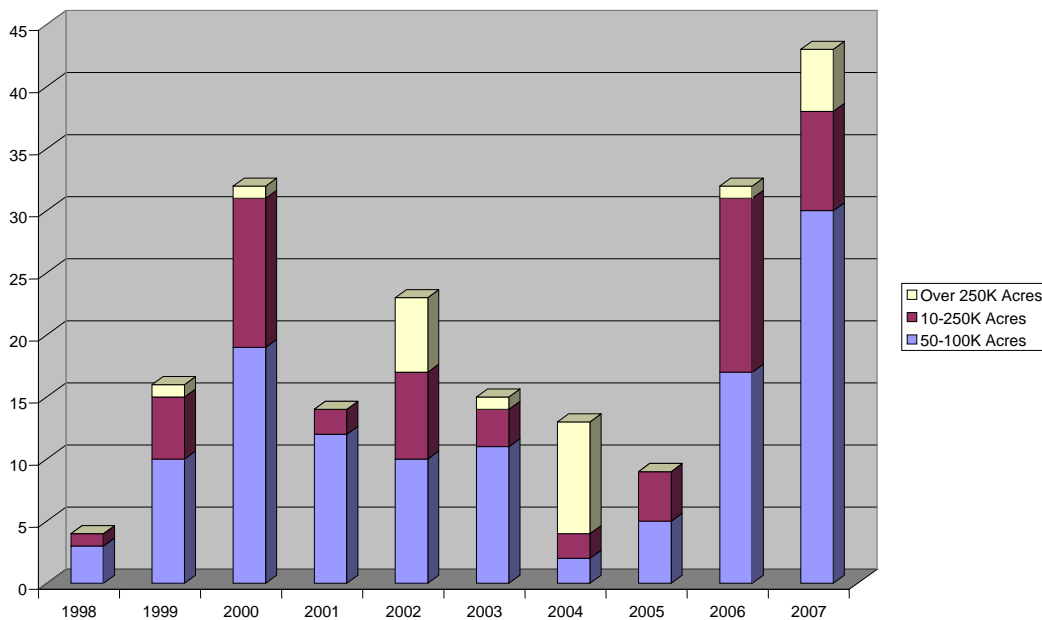
Introduction: The 2007 Fire Season

“The second costliest on record”¹

In 2007, there were 27 wildfires in the nation where the suppression cost exceeded \$10 million. Altogether the total suppression cost approached \$550 million, exclusive of burned area emergency rehabilitation costs, and accounted for less than 3 million burned acres. All wildfire acres reported to the National Interagency Coordination Center in 2007 were 9.32 million acres at a federal cost of nearly \$1.8 billion for the calendar year.² The 27 fires in this year’s review occurred in six regions and included 23 fires managed by U.S. Forest Service and four by Department of Interior agencies. The 2007 fire season was second to 2006, which set the modern historical record for wildfire activity, in terms of total acres, number of fires, and suppression costs. Together, these two fire seasons dramatically illustrate a new level of wildland fire in the United States.

In its 2006 review, the Panel commented on the various causal factors and driving forces for this new outlier in terms of fire activity experience. To those observations should be added that the 2007 fires reconfirm the emergence of “new” size categories of large wildfires. Excluding Alaska, 2007 accounted for 4 of the top 10 largest fires in the last decade, all exceeding 250,000 acres. Further, as the figure below shows, the number of wildfires over 50,000 acres reached a 10 year high in 2007.

Figure 1. Large Wildfires Over 50,000 Acres - 1998-2007



Source: QFR 2007 Advance Report, based on data supplied by National Interagency Fire Center. January 2008.

¹ The Idaho Statesman “2007 wildfire season the second costliest on record” Keither Ridler, Associated Press Jan 7, 2009.

² National Interagency Coordination Center. “Wildland Fire Summary and Statistics.” 2007. pg 17.

These large wildfires are still only a very small percentage of the total number of wildfires. They accounted for 0.05% of the more than 85,000 fires that occurred in 2007, and only 3.35% of the 1,284 “significant fires” reported by the National Interagency Coordination Center.³ While on representing a small portion of the wildfire activity they obviously have a massive impact on fire management losses and costs.

Fire sizes in this range have almost overwhelmed the ability of the public to understand how big they really are. The news print media is starting to describe the size of large wildfires in this category in terms of square miles affected. For example, last summer the print media described the area of Idaho’s complex fires as covering 3,100 square miles. Similarly, the Murphy Complex fire was described as burning “an area on the Idaho-Nevada border larger than Rhode Island.”⁴

Table 1 (on the next page) lists the 27 fires evaluated in 2007, by region and agency unit, along with the fire size, cost, and duration. More detail, including pre-fire and incident management condition is provided in the Supplemental Tables at the end of the report. As it did last year, the Panel compiled information on the four pre-fire conditions and three post-fire conditions generally considered important elements in determining fire behavior. The following comparison of the 2006 to 2007 fire season shows similar or worsening fire risk conditions in 2007.

	<u>2006</u>	<u>2007</u>
Pre-fire conditions on day of ignition		
Regional and national preparedness levels at 4 or 5	10 of 19	17 of 27
Fuel energy release index near the 90 th percentile and extreme fuel loading in area of fire	16 of 19	26 of 27
Extreme weather conditions (temperature/humidity)	14 of 19	27 of 27
Fire conditions during fire		
Ignition in a remote location	11 of 19	13 of 27
Burning in rugged terrain	8 of 19	19 of 27
Major wind event(s)/dramatic change in fire spread	7 of 19	7 of 27

A theme that emerged this year was that more descriptions of fires as fuels-driven were reported to the panel, as opposed to wind event or weather shifts. As fire events become longer, weather factors may yield to fuels levels as fire risk drivers.

³ NICC defines significant fires as those that “are a minimum of 100 acres in timber fuel types and 300 acres in grass and brush fuel types, or are managed by a type 1, 2, Fire use management team or NIMO incident management team.”

⁴ The Idaho Statesman, Jan 7, 2009.

Table 1 – FY 2007 Fires that Exceed \$10 million (Reviewed by the Panel)

	Fire Name	Forest (or other unit)	Start Date	Size (Acres)	Cost (\$)	Days to Type 3
REGION 1	Ahorn	Lewis & Clark NF	11-Jul-07	52,505	\$17,580,648	70
	Rattlesnake	Nez Perce NF	13-Jul-07	102,000	\$18,101,440	71
	Skyland	Flathead NF	18-Jul-07	45,760	\$18,019,336	44
	Brush Creek	Flathead NF	26-Jul-07	29,921	\$15,917,971	35
	Sawmill Complex	Lolo NF	31-Jul-07	68,500	\$20,666,708	63
REGION 4	East Zone Complex	Payette NF	7-Jul-07	300,022	\$32,509,311	80
	Middle Fork Complex	Boise NF	16-Jul-07	17,416	\$14,804,351	31
	Cascade Complex	Boise NF/ Salmon Ch NF	17-Jul-07	302,376	\$40,734,138	71
	Landmark Complex	Boise NF	4-Aug-07	47,270	\$12,664,617	14
	Castle Rock	Sawtooth NF	16-Aug-07	48,520	\$24,727,240	29
	Grays Creek	Payette NF	30-Aug-07	24,900	\$10,955,231	16
REGION 5	Angora	LTBMU	24-Jun-07	3,100	\$12,374,637	10
	Zaca Two	Los Padres NF	4-Jul-07	240,207	\$102,673,122	66
	Antelope Complex	Plumas NF	5-Jul-07	22,902	\$10,700,000*	10
	Elk Complex	Klamath NF	10-Jul-07	17,684	\$18,326,457	27
	Moonlight	Plumas NF	3-Sep-07	64,997	\$33,088,547	23
	Butler 2	San Bernardino NF	14-Sep-07	14,039	\$15,456,014	12
REGION 6	Egley Complex	Malheur NF	6-Jul-07	140,359	\$16,296,760	19
	Monument Complex	Umatilla NF	13-Jul-07	54,000	\$11,634,250	20
	Battle Creek Complex	Wallowa-Whitman NF	14-Jul-07	84,943	\$14,654,454	28
	Poe Cabin	Wallowa-Whitman NF	18-Jul-07	58,520	\$15,397,801	35
	Domke Lake Complex	Okanagon-Wanatchee NF	5-Aug-07	11,550	\$12,100,991	27
R 8	Florida Bugaboo	Osceola NF	5-May-07	108,754	\$12,350,000*	33
R9	Ham Lake	Superior NF	5-May-07	36,443	\$11,017,155	19
Other	Big Turnaround Complex	Okefenokee Wildlife Ref.	16-Apr-07	388,017	\$27,777,174	70
	WSA Lightning Complex	Warm Springs	12-Jul-07	13,077	\$19,484,110	42
	Murphy Complex	BLM-Idaho	16-Jul-07	652,016	\$10,551,611	16

Source: Final ICARS data submitted for each incident, provided by NIFC

* Final ICARS not available, final IC 209 reported cost used, provided by NIFC

Comparing 2007 Fires to 2006 Fires

If there is any advantage to having a greater-than-expected sample of large wild fires two years in a row is that it does provide a basis for comparison. The panel’s review design used the 2006 fire data (20 fires across 5 regions, burning 1.1 million acres at a cost of \$470 million) as a baseline. The total fire statistics are roughly equivalent for 2006 and 2007 (using NIFC reporting data)⁵; however there is a major difference between the years in the number of fires costing more than \$10 million.

All Fires	Number Of Wildfires	Total Acres Burned	Total Federal Suppression Cost (Fiscal Year)
2006	96,385	9,873,745	\$ 1.9 billion
2007	85,705	9,328,045	\$ 1.8 billion

Fires costing \$10 million or more

2006	20	1,039,461	\$ 477.9 million
2007	27	2,949,798	\$ 547.5 million

While the 2007 fire season was slightly smaller in total acres burned, it had 4 of the top 10 large fires in terms of size (2 Forest Service, 2 Department of Interior—all over 250,000 acres). In 2006 only one fire was close to 250,000 acres. If the misguided metric of cost per acre were applied to these two fire seasons one could conclude that 2007 was a “sensational” year. Sensational in this instance because the cost of fire suppression effort decreased from \$459 per acre in 2006 to \$189 per acre in 2007. This obviously misleading comparison reinforces the position of the 2006 Large Fire Panel and many others that cost per acre is not a meaningful measure. It is the opinion of the Panel that it is not only an inappropriate metric, but it is also counterproductive to the objectives of fire cost management.

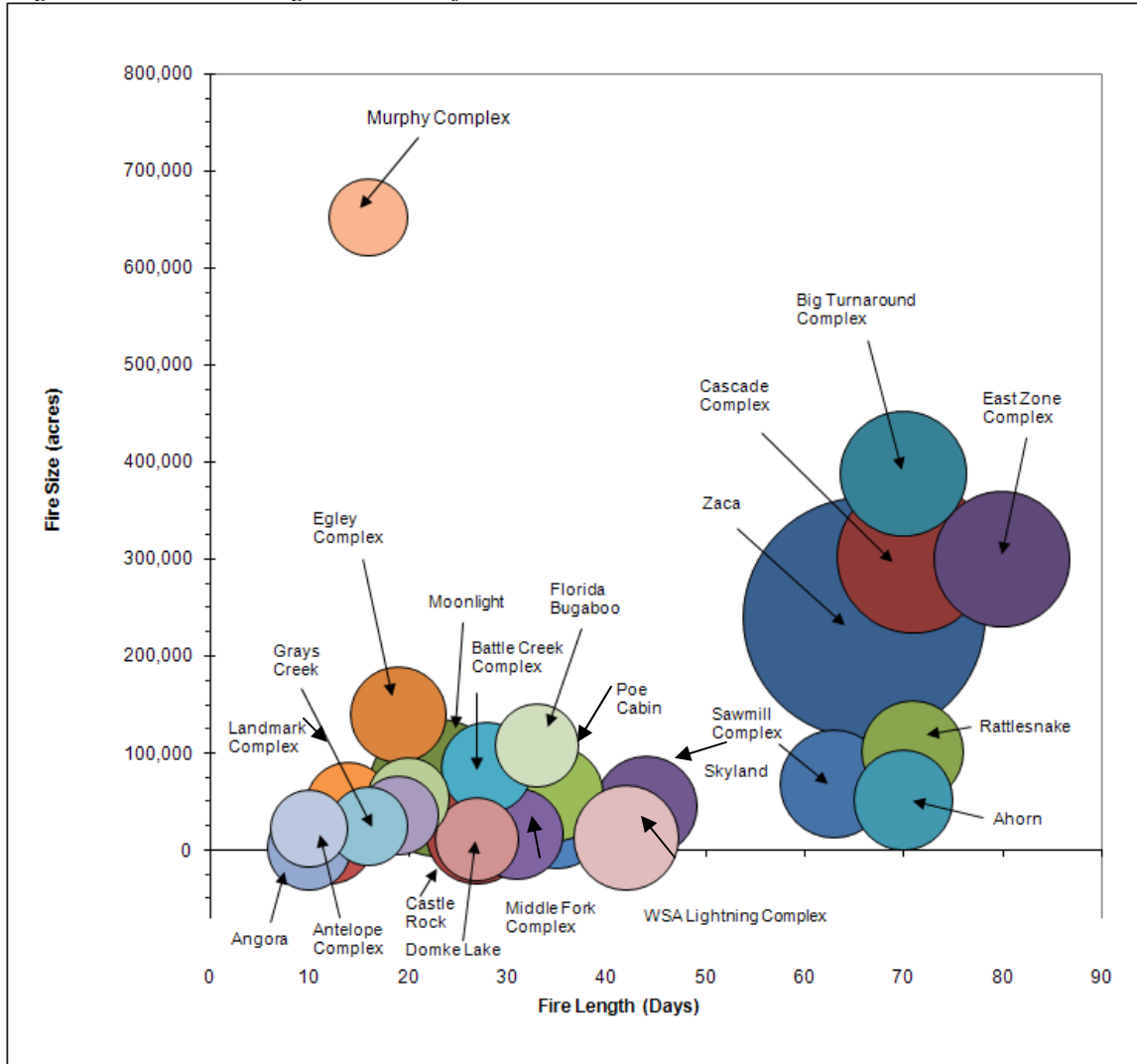
The panel chose to use time (or fire duration) as a core variable for categorizing the two fire samples. Fire duration, in this review, is defined as the length of time the fire was managed by a type 1 or type 2 team, before it was turned back over to local unit control. This is a somewhat problematic measure, because reporting on fires by incident management teams can vary, sometimes stopping before, sometimes continuing after the fire is in a land restoration stage. The panel expected to see larger-acreage fires resulting in longer-term management strategies.

	<u>2006</u>	<u>2007</u>
Short term fires (28 days or less)	5	13
Medium term fires (29 to 41 days)	5	5

⁵ With three different data reporting systems, there is considerable variance among data sets, further complicated by some systems reporting for the fiscal year and others for the calendar year.

The graphic that follows provides another view of this time categorization. Each fire is scaled to cost (size of the bubble) and charted by size and time.

Figure 2. The 2007 High Cost Wildfires



Note: The circle size represents the total suppression cost. The smallest circle represents the Murphy Complex at \$10.5 million and the largest circle represents Zaca II at \$102.7 million.

Source: ICARS data (see Supplemental Table 1)

Four of the longer term fires are in the top five largest fires of the 2007 sample—Zaca in California, East Zone and Cascade in Idaho, and Big Turnaround in Georgia. The Panel recognizes that the length of time the fire is managed outside of local control (and under the suppression budget) is only one factor among many. It was chosen as a means to cluster the fires and allow some comparisons of these two samples of fires.

The Panel used two other variables in 2006 to examine how large and high cost fires are affecting fire suppression strategies: complex management (multiple fires under one area

management), and multi-jurisdiction (fires crossing federal unit boundaries onto other state, tribal, private, or community lands). Only 15 of the 27 (56%) fires in 2007 were managed as complexes compared to 13 out of 18 (72%) in 2006. But there was a higher percentage of multi-jurisdiction fires in 2007; 22 of the 27 fires in 2007 fires (81%) compared to 12 out of 18 fires (67%) in 2006.

Table 2 also shows a difference between 2006 and 2007 in how fires were staffed with Type 1 and Type 2 Incident Management Teams and Wildland Fire Use teams. The totals are similar for both years (see Table 3). In 2006, 29 Type 1 teams and 36 Type 2 teams were deployed over a total of 930 days on the 18 fires. In 2007, 34 Type 1 teams and 43 Type 2 teams were used over 981 days on 27 fires. The difference is that more Type 2 teams were employed on longer term fires in 2007 than the previous year. In 2006, 53% of the teams managing long term fires (lasting more than 41 days) were Type 1 teams (18 teams) and 43% of the teams were Type 2 teams (16 teams). In 2007, 43% of the long term fire teams were Type 1 teams (17 teams) and 56% were Type 2 teams (22 teams). One possible contributing factor in explaining how this change occurred might be lower use of complex management control on long term fires in 2007. In 2006, 67% (4 of 6) of the long term fires used complex management control. In 2007, 56% (5 of 9) of the long term fires were complexed. This is not to say that complex fire management will always draw more Type 1 teams, but the complexity analysis process used to select the type of team would more likely result in this decision.

Taking into account the length of the fire, the panel observed a difference between the mean costs of the long term fires in the range of 10-15%. If the two most expensive fires (Tripod in 2006 and Zaca in 2007) are removed as outliers, the cost difference is more significant; nearly 25% lower in 2007. This would appear to be caused by the use of Type 2 teams and longer term suppression strategies, such as point protection as opposed to perimeter control. One more controlling factor was considered, and that was whether there was a discernable difference in staffing and resource levels between Type 1 and Type 2 teams. Table 2 illustrates staffing levels (crew resources) for IC teams and finds that on short term and longer term fires (22 of the 27 fires) the expected staffing difference does exist.

Table 2. Staffing of IC Teams on all 2007 Large Fire, Except the Large WUI Fires, Butler and Angora (outliers)

Fire Duration	Type 1 IC Teams		Type 2 IC Teams	
	Total Number of Days Assigned	Average Staffing per Team	Total Number of Days Assigned	Average Staffing per Team
Short Term	94	896	96	484
Moderate Term	70	304	73	387
Long Term	237	851	245	447
TOTAL	401		414	

In summary, the panel found some differences between these two record-setting fire years that indicates progress in incorporating cost containment as a factor in the choice of

suppression tactics and resource use. Shifting to more of a bi-modal approach that treats longer-term fire management differently and scales differently the use of national resources and aviation assets (to be examined later) is not an insignificant step.

Table 3. Comparison of 2006 and 2007 Wildfires

	Short Term Fires (28 days or less)		Moderate Term Fires (29 to 41 days)		Long Term Fires (42 or more days)	
	2006	2007	2006	2007	2006	2007
Number of Fires	6	13	6	5	6	9
Number Complexed	2	8	4	1	4	5
Number Multijurisdictional Fires	2	11	3	4	6	7
Number of Type 1 Teams	5	11	6	6	18	17
Number of Type 2 Teams	9	14	11	7	16	22
Number of NEMO Teams	NA	0	NA	1	NA	1
Number of Fire Use Teams	1	0	0	2	1	2
Mean Cost (\$ million)	\$13.08	\$14.60	\$16.78	\$16.64	\$35.92	\$33.06
Mean Cost ¹ w/o outliers					\$28.26	\$24.36
Mean Size (acres)	17,077	90,323	39,674	52,626	106,048	168,052
Mean Size ² w/o outliers (acres)		43,516			82,543	

¹ The Tripod Complex in 2006 and the Zaca II fire in 2007 were considered outliers for the mean cost calculation as they were more than 200% greater than the mean cost for all fires in their respective category.

² The Murphy Complex in 2006 and the Derby fire in 2007 were considered outliers for the mean size calculation as they were each more than 500% larger than the mean size for all fires in their respective category.

Evaluation Design and Framework

The Panel was asked to examine and report on fire suppression costs for wildfire incidents during Fiscal Year 2007 that exceeded \$10 million in accordance with the

following instructions: “This Panel is not expected to complete an exhaustive fiscal audit of all incident phases. Rather, the focus will be targeting risk-informed management.” In addition, the Panel was asked to examine these other objectives:

- a. Progress of the agencies’ transition to risk-informed management;
- b. Centralization of management of national shared resources;
- c. Demonstrated progress in aviation resource cost management;
- d. Agencies’ adherence to severity limitations and effective use of decision support technology, including the Stratified Cost Index, to support strategic incident management decisions; and the
- e. Value of the regional fire reviews and the Chief’s Principle Representatives’ reports in advancing cost containment goals.

To accomplish an independent review of fire incident cost management and the supplemental objectives, the Panel’s evaluation framework was designed to examine fire suppression management first from the unit’s vantage point. Each unit responsible for managing these 27 incidents was asked to provide a set of planning, incident management and reporting, mapping, and post-incident review documents. This advance data set was important because the number of fires to be reviewed precluded the 2006 Panel’s practice of conducting extensive site visits for one to two days for each incident. A schedule for regional office or center visits was established instead. It allocated at least a half day for each unit to conduct either the review either in person or via telephone conference calling or video conferencing.

The Panel adopted a protocol that it forwarded to each unit after it received the advance information. This list of subjects addressed and questions asked began with a review of pre-fire conditions and fire prevention planning. It extended through all stages of initial and extended attack, large fire incident management, and restoration and landscape rehabilitation efforts. The list below details the information request:

Related to Land and Fire Management Conditions

- Land/Resource Management Plan
- Fire Management Plan
- Cost sharing agreements (if applicable)
- Fire history table, depicting last 10 years of activity, number of fires, large fires, and acres burned
- Fuels management table, depicting last 10 years of acres treated and how they were treated (prescribed burn or mechanical) and where (WUI or wildland)

Related to the Specific Fire Incident

- Fire Chronology Table (showing incident core events by day--date, significant weather event, acres burned to date, losses (structures, lives, injuries,) WFSAs & IMT transitions, resources assigned (crews, engines, aviation assets, overhead, total personnel) and cost.

- Maps: Final Fire Perimeter, Fire Progression, Fire Severity, Fire History (last 10 years), Fuels Treatment (last 5 years), and a map showing strategy/application of WFU or Point Protection (if involved)
- WFSA's & Letters of Delegation of Authority
- Long Term Management Plans or Assessments (if applicable)
- IMT Narratives (all IMTs until turned over to Local type III team)
- Aviation Report (summary/record of use of aviation assets)
- Situation reports (209's) & ICARS (daily fire costs) Reports, provided by NIFC

Other considerations were factored into the evaluation design for the 2007 review. Since 2004, a great deal of activity and commensurate evaluation effort has been generated on cost containment. Most large wildfires now have an assigned (and trained) incident business advisor who works for the forest supervisor or agency administrator. The advisor ensures fiscal integrity, monitors resource ordering and contracting, and reports on cost economy measures. This year, national team incident commanders began reporting on the cost avoidance and cost saving steps and actions their teams were taking to exercise better fiscal management. Additionally, designated reviewers were assigned to large fires by the regional office and nationally from the Chief of the Forest Service's office. These reviewers were expected to add an additional perspective on suppression strategy and fiscal awareness. Finally, this independent national review follows a series of regionally required reviews for all fires that exceed \$5 million. Efforts in this year include raising the evaluation standards for regional reviews, presenting more systematic post-incident data collection and providing training for reviewers. This year the Panel was asked to include in its review how these efforts have added value to the pursuit of cost containment. One section of the Panel's recommendations is devoted to these reviews, which are further discussed in an appendix to this report.

Panel Review of Fiscal Diligence

Part of the Panel's purpose was to assess whether the agency administrator and his or her staff responsible for each incident had "exercised fiscal diligence in managing specific incident suppressing activities." The Panel formally voted no, based on the field reviews and other documentation provided, on whether there was any indication of fiscal malfeasance.

As noted, this year's review process was much more focused on strategic issues than last year's. So it should be added that the Panel's assessment was based primarily on its review of the documents and summary discussion with the unit and its fire staff. In these discussions the Panel noted fire situational strategic and tactical decisions that were not universally accepted by all the participants on fires. There are disagreements on tactical objectives and suppression strategies among line officers, fire staffs, and incident commanders, which are often complicated further by different expectations and fire management goals for neighboring jurisdictions. The Panel sometimes questioned suppression strategies as potentially being overly conservative or highly risk adverse. But

these positions and actions should not, and were not, viewed as indicating fiscal malfeasance.

Panel Findings and Recommendations

The following four issue areas were reviewed.

- Land Management and Fire Management Plans as Strategic Frameworks
- Wildland Fire Situational Analysis Effectiveness and Cost Factors
- Incident Management Team Staffing & Transitions
- Reviews, Reports and Outcome Metrics

The review of the first three is based extensively on last year's review criteria and findings. It was intended, in part, to ascertain whether progress is being made in moving towards an integrated risk and cost fire management strategy. Findings in these issue areas are based on frequency of occurrence in the fires reviewed. Supplemental tables showing unit by unit, incident by incident details are located at the end of the report.

Land Management and Resource Plans and Fire Management Plans as Strategic Frameworks for Managing Fire Suppression Investment

Last year's review cited the importance of the Land Management (and Resource) Plans (hereafter referred to as simply LMPs) and the Fire Management Plans (FMPs) as the two main documents that provide direction and guidance for all the activities undertaken by a national forest or land unit in managing national forest or land area resources. The Panel's view remains that these two planning documents should provide a clear line of sight for unit personnel and neighboring jurisdictions about fire management goals, strategies, and priorities.

This year's review offered the Panel a view of 21 LMPs and FMPs; 14 in "new" Forests or Interior agency units not previously reviewed and 7 in "old" land units that were reviewed last year. As it did last year, the Panel identified several core criteria for its review of these planning documents. The panel developed a list of the elements of LMPs and FMPs that it considered to be important in guiding fire managers as they develop fire tactics and strategy. These include a discussion of:

1. Fire history that provides an understanding of past fire behavior and an indication of the types of fires expected;
2. The types of fuels, typical fuel levels, and hazard fuel reduction treatments;
3. The presence of communities and structures adjacent to and intermixed in the area (wildland/urban intermix and interface or WUI) and expected changes in demographics;
4. The use of fire to accomplish resource management objectives (wildland fire use or WFU)

5. The application of Appropriate Management Response (AMR) strategy to the management of a fire in LMPs revised since 2000, or a discussion of using appropriate suppression response (asr) measures in earlier LMPs.

A. Land Management Plan Findings

Table 4 summarizes the discussion of key elements in Land Management Plans . A complete listing of the plans is included in Supplemental Table 2b.

Table 4 – Summary Assessment of Land Management Plans

Time period	DL*	Fire History	Fuels Treatments	WUI	WFU	AMR	asr**	Cost Containment
1985 – 1988 (8 plans)	G	4 of 8	8 of 8	2 of 8	3 of 8	0	4 of 8	0
	M	0	0	0	2 of 8	0	0	0
	D	0	0	0	0	0	1 of 8	0
1989 – 1999 (6 plans)	G	2 of 6	1 of 6	1 of 6	5 of 6	1 of 6	5 of 6	1 of 6
	M	0	1 of 6	1 of 6	1 of 6	0	0	0
	D	0	0	0	0	0	0	0
2000 – 2006 (7 plans)	G	4 of 7	3 of 7	0	4 of 7	3 of 7	n/a	0
	M	2 of 7	3 of 7	2 of 7	0	0	n/a	0
	D	0	0	0	0	0	n/a	0

*DL = Discussion Level: General (G), Moderate (M), and Detailed (D)

** asr, or appropriate suppression response is a tactical decision, different than Appropriate Management Response as a strategy

Basically, the Panel found that of the 21 Land Management Plans applicable to the 27 fires, none of the LMPs had what could really be considered a detailed discussion of all of the above key elements. These elements would provide significant information needed for developing and sustaining an effective fire management approach and strategy. Only one LMP (dated 1990) mentioned cost containment as a fire management objective. Prior to 1999 about half of the LMPs evaluated had a general discussion of appropriate suppression response. After 1999 about half of the LMPs had a general discussion of AMR. There is a slight trend towards more detailed discussion of these elements in the later LMPs, but the Panel considers it a modest trend with much room for improvement.

The Panel also recognizes that there are major impediments to providing LMPs with current information about the elements listed in Table 4. This was an observation reinforced during the field review discussions with the units. There are two important factors to consider. First, the length of time it takes to research, analyze, draft, review, and finalize a land/resource management plan is approaching 5-8 years. As an example, even the recent LMPs of the Boise and Payette National forests—approved in 2003—were basically drafted in the late 1990s. The length of time it now takes to develop an LMP may be eclipsing the ability of a plan to consider current fire effects. Second, the Panel is well aware of the not insignificant legal challenges and political obstacles that confront federal LMP revision efforts. While the Panel stresses the importance of the transparency

and clear strategic guidance that should come from an LMP regarding fire management, those same virtues can greatly complicate the approval process.

B. Fire Management Plan Findings

Up to date, clear guidance and transparency were also issues of concern in the Fire Management Plans. Table 5 summarizes the review of the same key elements in Fire Management Plans. A complete listing of the plans is included in Supplemental Table 2b. Here the panel expected to see more currency among the FMPs because of the requirement that they be updated annually, prior to fire season.

Table 5 – Summary Assessment of Fire Management Plans

Time Period	DL*	Fire History	Fuels Treatments	WUI	WFU	AMR	Cost Containment
2003 (1 plan)	G	0	1 of 1	0	0	0	0
	M	0	0	0	0	0	0
	D	0	0	0	0	0	0
2004 (2 plans)	G	2 of 2	2 of 2	1 of 2	1 of 2	0	0
	M	0	0	0	0	0	0
	D	0	0	0	0	0	0
2005 (2 plans)	G	0	2 of 2	0	1 of 2	0	0
	M	1 of 2	0	0	0	1 of 2	0
	D	0	0	0	0	0	0
2006 (5 plans)	G	1 of 5	4 of 5	3 of 5	1 of 5	1 of 5	0
	M	1 of 5	1 of 5	1 of 5	1 of 5	0	0
	D	0	0	0	0	0	0
2007 (6 plans)	G	7 of 11	7 of 11	7 of 11	7 of 11	8 of 11	5 of 11
	M	2 of 11	3 of 11	0	3 of 11	1 of 11	0
	D	0	0	0	1 of 11	2 of 11	1 of 11

*DL = Discussion Level: General (G), Moderate (M), and Detailed (D)

Of the 21 Fire Management Plans reviewed, 12 were not current, but rather were dated prior to 2007. Among the updated FMPs, when past plans were compared, the level of change in the FMP overview section was very minimal, and even these often did not address key component changes.

The Panel, however, recognizes a larger problem with FMPs than merely keeping them updated. Part of this problem is a difference in organizational perspective. Many of the units do not see FMPs as a strategic document in fire management. Rather their view of the FMPs is that of a repository for their fire management written policies, operational processes, communications information, and corresponding documents. Essentially, they see updating FMPs as making these “tactical directories” current. When new policies emerge or changes are announced, these are added as appendices. Where FMPs are being changed, it is to increase application of wildland fire use or to announce general guidance

about how appropriate management response can be employed. Several Forests also noted that unresolved legal challenges curb the unit's desire to significantly revise an FMP.

While recognizing this difference in perspective, the Panel still stands by its findings. This year and last year, the FMPs reviewed did not have enough detail and discussion of the key elements to provide significant information and direction for developing an effective fire management strategy, much less a transparent one for sharing with neighboring communities and other jurisdictions. The majority of the current FMPs do cover the key elements, but only in a brief and general discussion. Only a few of the 2007 plans have a moderate level of discussion that provides sufficient guidance to help formulate fire management strategy. The Panel found that only one plan had a detailed discussion of cost containment and wild fire use that fully explained those two issues. Two FMPs had detailed discussions of AMR principles. Just one or two others had truly current fire history information (as of 2006). So, there is a slight trend towards more detailed discussion of all the elements in the up-to-date FMPs, but this is at best a modest step with much room for improvement.

The Panel also requested recent historical information about fuels treatment efforts in the forests and units since 2000 in order to obtain a sense of potential future impact. While the information collected to date is only partially complete, it does show that most of the units are meeting the fuels reduction targets set in 2006 and 2007. Unfortunately, the efforts devoted to fuels reduction, while meeting forest goals, lag considerably behind recent fire activity. Even units with aggressive fuels programs were treating less than 2-3% of the total unit acreage annually. The Panel would reiterate its point from last year's report: current fire activity, especially at the record fire levels of the last few years, is "significantly outpacing fuels reduction efforts."

Lastly, in this issue area, there may be an opportunity in the debate over how fire management plans can (or perhaps should) be updated and made more robust at the unit level to promote a more collaborative approach. One of the Panel members explored at length with nearly all of the units, their perceptions of progress and the value of community wildfire protection plans (CWPPs). Except for some units in more remote areas, the majority of units mentioned the widespread development of CWPPs in adjacent communities. There was clearly enthusiasm for CWPPs and recognition of their potential. However, there was not any clear reciprocal commitment by federal units to collaborate with communities in their FMP processes. Nor was their dedication to finding ways to integrate community CWPP efforts with federal fire prevention and suppression planning, beyond cooperating on occasional fuels treatment initiatives.

The Panel certainly recognizes that the stewardship responsibilities and procedural processes of federal planning processes for land and fire management are considerable. But it feels there might be an opportunity to broaden and link these fire planning and prevention processes. The Panel's hope would be that in the future, pre fire season discussions among federal land managers and neighboring jurisdictions go beyond

the “usual suspects” issues list of cost share agreements, protection boundaries, evacuation plans, and occasional fuels treatment projects. Rather these annual discussions should include jurisdictional land and resource objectives, perceptions of fire risk and cost, and environmental outcomes.

C. Recommendations related to Land Management and Fire Management Plans

- **Recognize the goal of transforming Fire Management Plans from static, program reference documents to more strategic assessments of fire management planning and policies, and develop a more selective approach to FMP revision.**

It is more important to have more dynamic, integrative, and collaborative FMPs than simply static updated versions. A more selective approach might be to engage in a more extensive revision process on a 3-5 year cycle, rather than making minor revisions of each plan annually

- **Continue expanding Appropriate Management Response guidance in Fire Management Plans with an aim to increasing transparency on the range of suppression tactics and alternatives.**

AMR will only be successful if it is clearly articulated and understandable to the public and neighboring partners and there are consistent definitions across the Forest Service regions and the five federal agencies

- **Create a stronger linkage from Fire Management Plans to Community Wildfire Protection Plans by building a more collaborative approach for fire prevention and protection planning.**

The requirement for federal units to update annually FMPs and the growing number of neighboring communities now developing CWPPs could be used as an opportunity to share information, link fire prevention planning efforts and engage the wider community in fire management.

The Wildland Fire Situational Analysis and Delegation of Authority as Fire Suppression Management and Cost Factors

In last year’s review, the Panel took special note of the Wildland Fire Situational Analysis (WFSA) process and resulting Delegation of Authority letters to incident commanders as pivotal cost management factors. This year, the panel reviewed 89 WFSAs on the 27 fires. See Supplemental Table 3A for a summary of the incidents and WFSAs results.

The statistic the panel was most interested in was the dismal performance of the initial WFSAs on high cost fires last year. In 2006, the final size of the fire exceeded the initial selected WFSAs target size on all 19 fires. The Panel’s conclusion was that the current WFSAs process on these fires was totally inadequate in helping Forests determine their suppression strategy; that is, the WFSAs failed in forcing the units to think big enough about the fire’s potential.

The 2007 performance of the WFSAs was noticeably better. (See table below). The target selected in the initial WFSAs held when compared to final fire size in 12 of 27 fires. The Panel sees ample evidence that, for the most part, units are no longer chasing the fire with the WFSAs but making WFSAs bigger and more robust to handle larger fires. The WFSAs in 2007 were better on short and medium term fires, where the target size held on 11 of 17 fires. Longer duration fires were more problematic; the initial WFSAs were large enough only once in 10 fires. But even in these long term fires, subsequent WFSAs were able to get ahead of the fire size in most cases, which wasn't the case in 2006. This is a bit more impressive when the greater average size of fires in 2007 is factored in.

Table 6: WFSAs Comparison 2006-2007

Days to final Type 3	Number of Fires		Number of WFSAs		Fires Exceeding 1st WFSAs Target	
	2006	2007	2006	2007	2006	2007
28 or less	6	12	20	33	6 or 100%	5 or 65%
29-41	6	5	16	15	6 or 100%	1 or 20%
42 or more	6	10	30	41	6 or 100%	9 or 90%

While WFSAs got better (or at least staff got better at doing WFSAs), the Delegation of Authority letters did not. They remained largely as before, neither providing realistic cost objectives nor performance measures for cost management, nor establishing suppression resource priorities to complex incidents.

A. Wild Fire Situation Analysis Findings

The Panel has chosen not to focus extensively on further steps to improve the WFSAs process since it is slated for replacement over the next two years. Findings and concerns are instead blended into the positive/negatives summary below which might be used as lessons learned for the next generation of wildfire prediction tools.

On the positive side, it appears the WFSAs process is more accepted and the product better prepared and more dynamic than in the past. Fewer WFSAs are being written for each fire, which suggests greater consideration is being given to the nature and dynamics of the suppression efforts. The advent of the Long Term Implementation Plan along with the WFSAs process is a positive step and one that can enhance, clarify and justify a WFSAs decision.

The Panel asks that other concerns about systemic weaknesses of the WFSAs process be considered in developing a replacement. These are listed below:

1. The new tools should accommodate fire complexes in a manner that addresses the different priorities and strategies inherent in multiple fires and over varying jurisdictions and landscapes. The Panel saw examples of WFSAs developed for complexes that set out a single strategy for the first-priority fire, and subjected the other fires in the complex to the same strategy. This process didn't necessarily meet the fire management objective(s) of the other fires in the complex.
2. There must be more emphasis on long-term fire scenarios. The common WFSAs look at a single decision (strategy) with a single trigger point. A campaign fire may require multiple strategies and numerous trigger points. Future tools should have a capacity for multiple decisions and trigger points.
3. The new tools should be developed with stakeholders and other partners in a more collaborative manner. Too often the strategies and trigger points identified in the WFSAs are at odds with other jurisdictional interests. Where necessary, the WFSAs process should be a collaborative process that recognizes other stated priorities and objectives. Any Long Term Implementation Plan attached to a WFSAs should also be endorsed by affected agencies.
4. A separate and more distinct method for establishing a cost containment objective must be identified. Establishing a cost containment goal through the WFSAs procedure was not an objective of the WFSAs process. This must be remedied and pursued in the delegation of authority process.
5. Long Term Implementation Plans should also include a section on cost containment strategies, or cost behavior strategies that can or should be adopted for the long-duration fire.

One of the supplemental objectives for the Panel's review was the examination of the long term assessments developed for many of these fires and the unit's perceptions of decision support tools such as FSPRO/RAVAR. No technical assessment of these documents or products was attempted. Rather, the Panel simply included the use of FSPRO and Long term assessments as an "interview question" to gauge unit responses. Normally, only one or two individuals responded to the question (usually the fire staff individual for unit). The results of this informal survey are therefore somewhat biased, since there was not time to go in depth on effectiveness, (nor did the Panel have a technical expert on hand to discuss specifics).

A summary of the Panel's notes on decision support tools are found in Supplemental Table 3B. Overall, the units were evenly divided in their perception of the value of the tools. There was a slight tendency for units with longer term fires and those where the WFSAs initial target was exceeded by the fire size to gauge FSPRO more positively. Whether that's an indication of more confidence in FSPRO or less confidence in the current systems is moot. The Panel's conclusion, essentially a non-finding, is that this even distribution shows potential as well as the problems with any new tool that will

require continued evaluation of its effectiveness and considerable education on its implementation and future use.

B. Recommendation related to the WFSA

- **Ensure that the next generation of decisional support processes for predicting fire risk and potential fire size learns from the WFSA process.**
The next generation of decision support tools for fire risk management must be able to address multiple fire strategies in complex management and longer term fire scenarios. These tools should enhance collaboration among stakeholders and incorporate cost management as a critical value in decision analysis.

Incident Management Team Structure and Transitions as Fire Suppression Cost Factors

The third issue addressed in last year's cost review was how the use of national incident teams affected cost margins on large wildfires. The Panel's recommendations in 2006 focused on setting up more flexible and responsive staffing decisions that would pull higher cost assets (national teams and aviation assets) off of longer term fire situations and look for better ways to reduce staffing levels when possible. Other recommendations were made in support of this approach to reassessing resource levels. These were intended to make resource levels more commensurate with cost management goals on both extended fires and fires where the suppression strategy under Appropriate Management Response might emphasize point protection as opposed to direct attack and full perimeter control.

A. Incident Management Staffing and Resourcing Findings

Obviously, all suppression strategies are situation specific. But what the panel sought to assess, and what was tasked to them as part of the list of supplemental review objectives, was whether there was more variation in 2007 on the selection of suppression approaches than 2006, and whether it mattered. As already discussed in this report, the Panel found indications of several elements that would be considered critical to cost management. First, on long term fires, there was more use of Type 2 teams than the previous year, which contributed to a lower costs per fire. Further, there was a marked difference in staffing levels between Type 2 and Type 1 teams. Secondly, on the majority of fires, except those fires in WUI forests, suppression tactics incorporated point protection (as reported on the situation reports). While not conclusive, these differences strongly indicate that a different approach is being applied and that positive results (i.e. lower costs) are being obtained on longer term large fires.

The use of aviation assets is harder to assess. Table 7 shows that aviation costs are at just under 18% of total fire suppression costs and seem to be declining as a percentage of total costs (see supplemental tables 4 for detail),

Table 7 – Use of Aviation Assets in 2007 High Cost Fires

	Short Term	Moderate	Long Term	All
	Fire		Fires	Fires
Fire Costs	\$135,213,615	\$80,847,363	\$313,002,001	529,062,979
Total Av Costs	\$25,526,848	\$14,658,267	\$54,749,744	\$94,934,859
Pct of Total	18.9%	18.1%	17.5%	17.9%
	Short Term	Moderate	Long Term	
Pct of Costs by quartile of fire length				
Fixed -1 st	14.1%	11.7%	7.9%	
Fixed -2 nd	5.9%	13.3%	10.8%	
Fixed -3 rd	2.4%	9.9%	5.0%	
Fixed -4 th	n.a.	3.0%	1.9	
Heli -1 st	29.9%	17.0%	15.4	
Heli -2 nd	35.0%	30.6%	27.2	
Heli -3 rd	12.7%	11.8%	21.8	
Heli -4 th	n.a.	2.7%	10.8	
All Aviation 1 st Period	44.0%	28.7%	23.3%	
All Aviation 2 nd Period	40.9%	43.9%	38.0%	
All Aviation 3 rd Period	15.1%	21.7%	26.8%	
All Aviation 4 th Period	n.a.	5.7%	12.7%	

Lower overall aviation costs are most likely attributable to national and regional decisions to contract for more exclusive-use aviation helicopters than call-when-needed aviation helicopters, thus lowering the overall cost. Table 7 shows a decreasing trend in aviation asset costs after the 2nd quartile on all fire sizes. In short, there is an indication that the majority of aviation assets were used in the front stages of high cost fires as opposed to the later stages. While this is not conclusive proof that aviation assets were used more for short term, initial attack stages than long term ends of fires, it suggests that there is a strong preference for downsizing the use of higher cost assets on extended fires; i.e., to avoid simply parking aviation assets on fires.

That said, there remains a larger problem of assessing cost management in fire suppression. One issue is how to evaluate a result when the objective is to decrease the rate of something that is growing (both the size of wildfires and the total costs). However, this review of 27 fires is focused primarily on how well demand for suppression resources and assets were managed. Aviation illustrates this perfectly. What is made available for fire support is often determined more by supply than fire management need. Some regions discussed the creation of zone systems to support multiple fires with air assets that are highly dynamic and responsive to need. Assets are reassigned daily based on demand. This is a good example of demand responsive fire suppression management, but the process makes it more difficult to determine the appropriate supply of assets.

The panel's finding in this issue area is that there were greater levels of flexibility in choice of incident management teams. This was especially the case in developing an extended cost strategy for longer fire events, managing complex fires, and using high cost resources; (i.e. aviation assets). The caveat is that these efforts are focused on managing the demand side of the suppression cost equation.

B. Recommendation related to Incident Management Teams and supporting assets as fire suppression cost factors

- **Continued pursuit of more flexible suppression strategies, especially on extended fires, matched with more judicious staffing and resource levels should be encouraged.**

As fire management improves its ability to manage suppression demand in a risk- and cost-sensitive context, it should seek to tackle the supply side of the fire management equation.

Pursuing the Next Stage of Risk Informed Management – What if?

The Panel's conclusion that progress is being made in incorporating cost factors into suppression management strategies opens the possibility of rethinking the larger framework for managing fire suppression resources. Consider a "what if" suggestion: that over the next several years, fire management consider a model for resource allocation for large fire suppression that follows what the military has adopted in this decade. Appendix A, written by our Panel member from the Rand Corporation, more fully explores the possibilities of moving towards this type of model.

This section addresses how to move fire management from risk-informed management to integrated risk and cost management. The following suggestion is premised on the potential to realize cost savings from changes in strategy, while realizing that getting these savings depends on having some essential elements in place:

- Full understanding of capabilities and their costs,
- Good situational awareness and confidence in accuracy of forecasts,
- Flexibility in use of resources, meaning modularity, so as to allow graduated response
- A linkage of the above elements with tools providing real-time decision support

A strategy change, from perimeter to point protection, can lead to cost savings, if it is combined with organizational changes and proper integration of technology to make the strategy work. The following four elements seem essential to achieving that goal:

1. Gain full understanding of capabilities and their costs. This entails working out detailed planning factors for all assets to inform calculations of tradeoffs. Having such building blocks of information, and making the information easily accessible will lead to

answering the question, “under what circumstances would more of X be a more efficient answer than use of Y?” For aviation assets, there is a need for a step by step assessment of where aviation capabilities are unique and where they are common.

2. Attain good situational awareness and confidence in accuracy of forecasts of fire progression. Efficient use of assets stems from an accurate assessment of the situation and understanding of the potential threat. Real-time situational awareness of fire progression, continuously updated, day and night, could be achieved with increased use of drone aircraft with infra-red sensors. The combination of improved fire behavior models, continuously-updated weather data, and knowledge of local topography and fuels presence provides the potential for coming up with fast and reliable forecasts of fire progression. They would be automatically presented in geospatial format that includes progress by time (days) and confidence levels.

3. Reorganize the assets so as to allow a flexible and graduated response. In general, some kind of modularity is essential. If the forecasts are reliable, then a proportional response tailored to the specific threat must be available. The organizational structure must allow for such flexibility.

4. Link all the above elements together with tools that provide real-time decision support. There is a need for an integrated tool that would link forecasts with capabilities and properly organized and flexible units. It would inform the judgment of an incident or area commander on the appropriate course of action, based on the commander’s choice of optimization.

Generally, applying these elements will lead to a portfolio-based strategy, so as to allow wise optimization across several scenarios. For example, a commander may optimize on the basis of “minimizing maximum regret,” with regret set at varying levels for different types of assets. In other words, what is called for is not a simplistic optimization tool with one answer. The commander should make the call with the ability to fully understand the choices and options. That means a tool that runs quickly (in minutes if not seconds) and can provide a variety of forecasts based on differences in what values are to be protected and what risks the local commander is willing to tolerate. The general goal would be robustness across potential scenarios. The objective is not to take away any commander’s wisdom and insight acquired over 20 years, but to give them the best informed set of options on which to base decisions. There are many existing tools the military uses that can be adapted for use in fighting wildfires.

Implementing the four elements outlined above, and especially putting in place decision support tools that are reliable and trusted by implementers, will lead to long-term behavior modification. It will further result in a different mentality, away from hoarding resources to willingness to part with them temporarily. It is in the course of such behavioral change that cost savings from strategy change will become realized.

Reviews, Reports, and Outcome Metrics

This year's review included several supplemental objectives for the Panel to assess, asking whether progress was being made by fire management towards risk-informed management. These objectives (risk-informed management; centralized management of national, shared resources and aviation assets; and decision support tools) have been incorporated as factors in the Panel's comparative analysis of 2006 to 2007 fire costs. They have also been included in the review of more strategic and cost sensitive shifts in types of teams and use of aviation assets in issue area 3.

The Panel did not examine severity funding requests and how they were managed by regions and units. Since the focus was primarily on units and incident management strategies and decisions, the information collected by the Panel did not provide a basis to evaluate severity. The Panel was able to examine in depth, and discuss with the units, the various post-incident reports, regional reviews, and narrative reports devoted to the 2007 fire incidents.

A. Effectively Targeting Large Fire External Reviews

In its interview process, the Panel asked about the Chief's Principal Representative (CPR) and regional reviews, the usefulness of the review process and reports for future improvements, and suggestions to improve the external oversight approach. While those interviewed believed there was merit in external reviews, they did have several concerns. To illustrate, some said the CPR tended not to have fire experience. CPR time at the fire was often considered an educational or training experience for Washington Office personnel, not a review of fire management decisions and significant fire events. Regional reviews heavily emphasized operational issues, and those primarily were process issues that were very insignificant in impacting the cost of the fire. For both, regions and forests often did have an opportunity to review draft reports to correct factual errors or provide content that would better explain fire events and decisions.

In addition, the Panel assessed the 2007 CPR narrative reports and regional reviews and found significant issues in the reviews. To illustrate, some reports were internally inconsistent, or the regional review was inconsistent with the CPR review done earlier. Many large cost review reports did not clearly link cause, condition, and the effect of problems.

The Panel believes an alternative external oversight model of reviews would better ensure an integrated review approach, and emphasize an evaluative framework from individual fires to national strategies. Specific thresholds would differentiate the fires that might be subject to regional and national independent reviews. The thresholds should also be based on higher cost levels, such as \$10 million and \$15 million respectively, as well as other significant factors, such as fires with major property losses and/or economic and social impacts.

As shown in Table 8, the Panel would suggest an oversight model emphasizing two major review perspectives. One divides individual fire management and resulting recommendations into three decision spaces: 1) preparedness and capabilities before the fire, 2) fire management during the term of the fire, and 3) any post-fire management lessons learned (or unlearned) and better practices for the next fire season. A second

perspective considers operational versus strategic concerns. For example, 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, the use of decision support tools and technologies during the fire.

Table 8. Oversight Review Model

Decision Focus	Pre-Fire (Preparedness)	Fire Event (Response)	Post-Fire (Better Practices)
Fire Review Selection Criteria	None: national forests to mitigate fire impact and related cost potential	Immediately after the end of the fire: All fires over criteria such as \$10 million in cost and/or with major impacts	All fires over \$15 million in cost and/or with major impacts
Strategic			
<ul style="list-style-type: none"> Methodology 	Forest/district self-assessment, subsequent regional review using set criteria; issuance of national report	Combined CPR Team and regional review using set criteria, issuance of regional and national “roll-up” reports	National independent panel review, issuance of national report
<ul style="list-style-type: none"> Coverage Examples 	Jurisdictional authority FMP and LMP coverage and currency Use of scenarios to anticipate short and long-term fires and complexity, given drought and fire severity indices and the reduction of natural barriers Risk management: identification of values at risk (WUI considerations) Community wildfire protection plans	FMP utilization LMP utilization Resource availability and constraints Cost containment actions Indirect suppression activities	Examination and analysis of regional fire reports In-depth fire site visits to further examine strategic concerns, identify and assess “successful fire” metrics and possible better practices for national application Review of other management and accomplishment reports
Operational			
<ul style="list-style-type: none"> Methodology 	National forest review using set criteria; report to region	CPR Team review using set criteria, findings provided to the host unit immediately	National independent panel review, issuance of national report
<ul style="list-style-type: none"> Coverage Examples 	Memorandums of understanding Cost sharing and cost apportionment agreements Local contracts Tool expertise: WFSA, FSPRO, RAVAR Resource and business planning and guidelines Community wildfire protection plan implementation	AMR and suppression alternatives Tool utilization: WFSA, FSPRO, RAVAR, SCI Delegation of authority Resource availability and constraints Cost containment actions National team rotations and capability to meet fire’s specific needs Documentation	Examination and analysis of CPR team reports In-depth fire site visits to further examine operational concerns, identify and assess possible better practices Review of other management and accomplishment reports

In addition, the Panel suggests that future oversight reviews and use of supplementary information such as the situation reports (209s) should consider the information and form required to best provide a picture of how wildland fires are being managed, including the cost perspectives. A useful model that might guide such a perspective is that described by Davenport and Harris in *Competing in Analytics* (Harvard Business School Press, Boston, Massachusetts, 2007). Figure 3 captures wildfire management questions for wildfire management, displaying both the current oversight intelligence sources and those proposed for the new oversight model.

Figure 3 Wildfire Management Reporting and Reviews as Organizational Intelligence

	Wildfire Management Questions	Intelligence Sources		
		Current	New Model	
Stewardship and Cost/Benefit Advantage	Mission success: What is our criteria for success and what is the best that should happen?	Strategic plans, performance reports, performance budgets	Strategic plans, performance reports, performance budgets	Analytics
	Predictive analysis: What might happen next?	National independent panel review (limited)	Washington Office and regional assessments; national independent panel review	
	Forecasting and projecting: What if these positive and negative trends continue?	National independent panel review (limited)	Washington Office and regional assessment of trends and impacts; national independent panel review	
	In-Depth Analysis: Why is this happening?	Regional reviews (limited)	Regional reviews	
	Problem Analysis and Action: What are the opportunities and problems and what actions are needed in the short and long term?	Regional reviews (limited)	After Action Reports, management year in review reports, accomplishment reports	Access and reporting
	Periodic reports: What summary reports provide the context and supplement our understanding?	CPR reviews, management year in review reports, accomplishment reports	National forest reviews; CPR reviews	
	Standard reports: What day-to day reports tell us what happened?	209s, IBAs, After Action Reports, ICARs	209s, IBAs, ICARs	
		Degree of Intelligence		

Internal and external fire reviews from incident commanders and business advisors to CPRs and to regional and external national review panels should be a set of aligned objectives. These objectives should move the organization beyond business reporting about what the current state is to organizational intelligence that assesses how close fire management is to a desired outcome.

B. Recommendation related to reviews, reports and outcome metrics

- **Revise the thresholds and selection criteria for regional and national reviews and tier the evaluation objectives of reviews to more strategically-based assessments of progress made towards desired outcomes.**

Reporting and review processes used currently to assess a range of management objectives – from fiscal integrity and cost controls to resource usage efficiency and strategic intent can and should be aligned to reflect larger analytical goals. Alignment would allow for better use of reporting information, easing data collection burden on units, and enhancing each review’s ability to produce less redundant, more in depth and better focused analyses, commensurate with each review’s objectives.

Rethinking Fire Outcomes: Moving Beyond Cost per Acre

In last year’s review, the Panel noted that a better set of outcome metrics was needed for fire management. This better metric, the Panel argued, should be more comprehensive in capturing 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.

The Panel offers for consideration the following concept which might be a step forward in understanding fire management as an investment, and in moving towards integrated risk and cost fire management. If outcome measurement in fire management was viewed as a sum of Losses plus Costs plus Severity; fire management could address several of the deficiencies of metrics based on cost per acre.

Figure 4 Variables in L-C-S Outcomes Measurement

Losses	Costs	Severity	DESIRED CONDITIONS
<u>Direct</u> Loss of life (public & fire fighters) Structures Economic losses (timber/ commercial)	<u>Tangible</u> Fuels reduction Initial attack Large fire suppression/WFU BEAR/stabilization /restoration	<u>Extent of Environmental Damage</u> Burn severity species/habitat Loss Biodiversity	
<u>Indirect</u> Health Effects of smoke Recreation Closed Highways	<u>Indirect cost to other entities for</u> Evacuation Closings EMR	<u>Indirect</u> Resiliency Stand Interval Watershed Carbon	

First, each of the variables could be compared to desired conditions in different regions as specified in a fire management plan. Second, fire management costs could include both beginning to end costs and other entities’ support costs. Third, variables such as severity and even structures in fire risk zones are now being captured in GIS mapping and may be more easily quantifiable. The panel recognizes that this won’t be easy. But if cost management is to be a core part of an integrated risk management approach, a metric that begins with desired conditions and includes both the costs and benefits of fire management seems essential.

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Supplemental Table 1A – Summary of Fires by Complex, Teams, and Jurisdictions

Fire Duration ¹	Fire Name	Complex (Multiple Fires)	# of Type 1 Teams	# of Type 2 Teams	Multi-jurisdictional
Short Term (28 or less days)	Ham Lake	No	1	1	yes
	Angora	No	1	1	yes
	Antelope Complex	Yes	1	1	yes
	Egley Complex	Yes	1	1	yes
	Elk Complex	Yes	1	1	yes
	Monument Complex	Yes	0	2	yes
	Murphy Complex	Yes	2	0	yes
	Landmark Complex	Yes	1	1	no
	Battle Creek Complex	Yes	1	1	yes
	Gray's Creek	No	0	1	yes
	Moonlight	No	1	1	yes
	Domke Lake Complex	Yes	0	2	no
	Butler II	No	1	1	yes
Moderate Term (29 to 41 days)	Bugaboo	No	3	0	yes
	Middle Fork Complex	Yes	0	3	no
	Poe Cabin	No	1	2	yes
	Brush Creek	No	0	2	yes
	Castle Rock	No	1	1	yes
Long Term (42 or more days)	Big Turnaround Complex	Yes	3	1	yes
	Zaca II	No	5	2	yes
	East Zone Complex	Yes	4	0	no
	Ahorn	No	2	3	yes
	Rattlesnake	No	0	6	yes
	Cascade Complex	Yes	4	4	yes
	Skyland	No	1	2	yes
	Sawmill Complex	Yes	0	4	yes
	WSA Lightening Complex	Yes	0	6	no

¹ Fire duration is the length of time from ignition to the time when the fire is transferred from a national Incident Command Team back to the local unit.

Supplemental Table 1B – Summary of Fire Conditions at Time of Ignition

Fire Type	Fire Name	Pre-Fire Conditions				Conditions During Fire			Total # of elements
		Nat./ Reg. Preparedness levels at 4 or 5	Fuel ERC In 90 th percentile	Heavy Fuel Loading	Extreme Drought Conditions	Remote Location	Rugged Terrain	Major Wind Event Effect	
Short Term (28 or less days)	Ham Lake		X		X			X	3
	Angora		X	X	X				3
	Antelope Complex		X	X	X		X		4
	Egley Complex		X		X			X	3
	Elk Complex		X	X	X	X	X		5
	Monument Complex				X				1
	Murphy Complex	X	X		X	X			4
	Landmark Complex	X	X		X	X	X		5
	Battle Creek Complex	X	X		X	X	X		5
	Gray's Creek	X	X		X				3
	Moonlight	X	X	X	X		X		5
	Domke Lake Complex		X	X	X	X	X		5
	Butler II	X	X	X	X			X	5
Moderate Term (29 to 41 days)	Bugaboo		X	X	X			X	4
	Middle Fork Complex	X	X		X	X	X		5
	Poe Cabin	X	X		X		X		4
	Brush Creek	X	X		X		X		4
	Castle Rock	X	X	X	X		X	X	6
Long Term (42 or more days)	Big Turnaround Complex		X	X	X	X	X		5
	Zaca II	X	X		X		X		4
	East Zone Complex	X	X	X	X	X	X	X	7
	Ahorn	X	X	X	X	X	X		6
	Rattlesnake	X	X	X	X	X	X		6
	Cascade Complex	X	X		X	X	X		5
	Skyland	X	X	X	X	X	X		6
	Sawmill Complex	X	X	X	X	X	X	X	7
WSA Lightning Complex		X	X	X		X		4	

Supplemental Table 2. Land Management and Fire Management Plans
2A. Land Assessment of key elements for each land unit, sorted by the date of the Land Management Plan

Unit	Date	Fire History	Fuels Treatments	WUI	WFU	AMR or asr*	Cost Containment
Flathead NF	1985	None	General	None	General	No AMR, General asr	None
Lewis & Clark NF	1986	None	General	None	Moderate	No AMR, General asr	None
Lolo	1986	General to 1974	General	None	General, OK in wilderness	None	None
BLM-Idaho	1987	General to 1987	General	None	None	None	None
Klamath NF	1988	None	General	None	None	No AMR, Detailed asr	None
LTBMU	1988	None	General	None	None	None	None
Nez Perce NF	1988	General to 1986	General	General	Moderate	No AMR, General asr	None
Plumas NF	1988	General to 1984	General	General	General, OK in wilderness	No AMR, General asr	None
Okanogan-Wanatchee NF	1989 and 1990	None on ONF, general to 1985 on WNF	None	None	General, OK in 9 of 16 LMAs on ONF and 33% of WNF	No AMR, general asr	None in ONF, General in WNF
Malheur NF	1990	None	None	None	General, OK on ~ 14% of unit	No AMR, general asr	None
Umatilla NF	1990	None	General	None	General, allowed	No AMR, general	None

Unit	Date	Fire History	Fuels Treatments	WUI	WFU	AMR or asr*	Cost Containment
					in wilderness (20% of unit)	asr	
Wallowa-Whitman NF	1990	None	None	None	General	No AMR, general asr	None
Osceola NF	1999	None	None	None	General, OK in wilderness	No AMR, general asr	
Sawtooth NF	1999	General to 1998	Moderate	Moderate	Detailed	General AMR	None
Warm Springs – BIA	2001	General	General	None	General, OK in all LMAs	None	None
Boise NF	2003	Moderate	Moderate	Moderate	General	General AMR	None
Payette NF	2003	General	General	None	General	General AMR	None
Superior NF	2004	None	General	None	General, OK in wilderness	General AMR	None
Los Padres NF	2005	None	Moderate	None	None	None	None
San Bernardino NF	2005	None	Moderate	None	None	None	None
Okefenokee Wildlife Refuge – FWS	2006	Moderate	None	Moderate	None	None	None

** asr = appropriate suppression response is a tactical decision, different than Appropriate Management Response as a strategy*

Supplemental Table 2B. Fire Management Plan Review

Assessment of key elements for each land unit, sorted by the date of the Fire Management Plan.

Unit	Date	Fire History	Fuels Treatments	WUI	WFU	AMR	Cost Containment
Warm Springs – BIA	2003	None	General	None	None, not approved for use in unit	None	None
Klamath	2004	General to 1999	General	General	General, OK on ~ 48% of unit	General	None
Osceola	2004	General to 2000	General	None	None, not permitted by State of Florida	None	None
BLM - Idaho	2005	Moderate to 2004	General	n/a	General OK in ~1% of unit	Moderate	None
Los Padres	2005	None	General	None	None, not allowed on the unit	None	None
Boise NF	2006	Moderate to 2006	General	Moderate	Moderate OK in wilderness (25% of unit)	Moderate	None
LTBMU	2006	None	Moderate	General	None, not allowed on the unit	None	None
Okefenokee Wildlife refuge	2006	None	General	None	General, OK on ~ 90% of unit	None	None
Plumas	2006	None	General	General	None, not allowed	None	None

Unit	Date	Fire History	Fuels Treatments	WUI	WFU	AMR	Cost Containment
					on unit		
San Bernardino	2006	General to 2003	General	General	None, no allowed on the unit	None	None
Flathead	2007	None	General	General	Detailed	General	Detailed
Lewis & Clark	2007	None	General	General	Moderate	Detailed	General
Lolo	2007	General to 2002	General	General	General	General	General
Malheur NF	2007	General not current	General	None	General, OK on less than 1% of unit	General	None
Nez Perce	2007	General	General	General	Moderate	General	General
Okanogan-Wanatchee NF	2007	General to 2000	General	General	General, OK in 33% of the unit	General	None
Payette NF	2007	General to 1994	Moderate	None	Moderate OK in ~85% of unit	General	None
Sawtooth	2007	General to 2004	None	None	General	General	General
Superior	2007	Moderate, up to 2006	Moderate	None	General, OK in one FMU, ~15% of unit	Detailed with examples	None
Umatilla NF	2007	General up to 2007	General	General	General, not approved for use in unit	General	General
Wallowa-Whitman NF	2007	Moderate to 2006	Moderate	General	General OK in 37% of unit	Moderate	None

Supplemental Table 3 – Comparative review of WFSAs
3A. WFSAs profile

Fire Duration	Fire Name By Fire Duration	Number of WFSAs	Fire Size Exceeded Initial Target	Used FS-PRO	Found FSPRO Useful	Multi-jurisdictional
Short Term (28 days or less)	Ham Lake	4	yes	n.a.	n.a.	yes
	Angora	2	no	yes	no	yes
	Antelope Complex	4	no	yes	no	yes
	Egley Complex	5	yes	yes	some	yes
	Elk Complex	2	yes	yes	yes	yes
	Monument Complex	2	no	yes	no	yes
	Murphy Complex	2	no	no	n.a.	yes
	Landmark Complex	1	no	yes	yes	no
	Battle Creek Complex	2	yes	yes	no	yes
	Gray's Creek	3	no	n.a.	n.a.	yes
	Moonlight	4	yes	n.a.	n.a.	yes
	Domke Lake Complex	2	no	yes	some	no
	Butler II	2	yes	yes	yes	yes
Moderate Term (29 to 41 days)	Bugaboo	3	no	n.a.	n.a.	yes
	Middle Fork Complex	5	yes	yes	yes	no
	Poe Cabin	2	no	yes	no	yes
	Brush Creek	3	no	yes	some	yes
	Castle Rock	2	no	yes	some	Yes
Long Term (42 or more days)	Big Turnaround Complex	5	yes	yes	no	yes
	Zaca II	4	yes	yes	yes	yes
	East Zone Complex	8	yes	yes	yes	no
	Ahorn	3	yes	n.a.	n.a.	yes
	Rattlesnake	3	yes	yes	some	yes
	Cascade Complex	5	yes	yes	some	yes
	Skyland	3	yes	yes	no	yes
	Sawmill Complex	4	no	yes	yes	yes
WSA Lightning Complex	4	?	yes	no	No	

Supplemental Table 3B. Field Interview Assessment of FS-PRO/RAVAR

Fire Name (by Region)	FS PRO Used?	Useful?	FS PRO ASSESSMENT
R1- Ahorn	?	N/A	
R1 -Rattlesnake	yes	0	NEUTRAL, SOMEWHAT USEFUL, POTENTIALLY PROMISING Yes, useful in generating discussion, but overall, NF did not find it greatly helpful; NF had difficulty in interpreting the results; accuracy of input information problematic
R1 - Skyland	yes	-	DEEMED INEFFECTIVE
R1 - Brush Creek	yes	0/-	NEUTRAL; POTENTIALLY PROMISING Useful in outlining impact of strong winds; but overall not all that useful; faulty wind data (based on location of weather stations in canyons); needs more information on fuel types
R1- Sawmill Complex	Yes	+	PROVIDED VALUABLE INFORMATION Useful for sharing information with the public and other partners; need to improve data input and train more people on the system
R4 - East Zone Complex	Yes	+	USEFUL, PROMISING, HAS SOME PROBLEMS Need more people trained on it, under predicted fire spread, missed wind events, challenged to pick up all the topographical features
R4 - Middle Fork Complex	?	0/+	General assessment by Boise NF: useful and promising
R4 Idaho BLM- (Murphy Complex	No	N/A	
R4 -Cascade Complex	Yes	0/+	SOMEWHAT USEFUL Utility greater at strategic level, less so at tactical level; not much confidence in predictions; need to train more people; best used when mixed with local knowledge
R4- Landmark Complex	?	0/+	General assessment by Boise NF: useful and promising
R4 - Castle Rock	Yes	0/-	SOMEWHAT USEFUL BUT NOT ALL THAT INSIGHTFUL Confirmed the “gut-level” analysis
R4 -Grays Creek	?	+	General assessment by Payette NF: useful and promising
R5 -Angora	Yes	-	NOT USEFUL Model inherently wrong, over predicted fire progression; potentially may be useful in some situations

Fire Name (by Region)	FS PRO Used?	Useful?	FS PRO ASSESSMENT
R5 -Zaca Two	Yes	+	USEFUL, PROMISING Needed some tweaking, justified some of the strategic decisions, but still very rough, true potential for cost savings, need more people trained, Overall a huge step forward
R5- Antelope Complex	Yes	-	BAD PREDICTIONS Predicted spread into a WUI community, concern over making strategic choices on the basis of incorrect forecasts
R5- Elk Complex	Yes	+	USEFUL, WORKED WELL Predicted fire behavior well, Klamath NF liked the tool
R5- Moonlight	?	-	General assessment by Plumas NF: poor predictive capabilities
R5- Butler 2	Yes	+	USEFUL, PROMISING Limitation is accuracy of inputs, need to integrate input of local expertise
R6- Egley Complex	Yes	0/+	SOMEWHAT USEFUL, PROMISING Takes too long to run, useful at strategic level, also useful for WFU areas
R6 - BIA -WSA Lightning Complex	Yes	0/-	Not accurate in predictions
R6 -Monument Complex	Yes	-	NOT USEFUL Local knowledge more on the mark, FS Pro predictions not all that useful
R6- Battle Creek Complex	Yes	0	Used for forecasts of how fire might spread beyond the wilderness
R6 – Poe Cabin	Yes	0	Needs to be integrated with local knowledge, need to learn how to use the information
R6- Domke Lake Complex	Yes	0/-	LIMITED USEFULNESS Results too late to influence decision-making
R8- FWS Big Turnaround Complex	?	N/A	Though an After Action review noted incompatibility with southern fuel types--- citing “models consistently underestimated rates-of-spread and other parameters on these fires under this drought condition”
R8 Florida Bugaboo	?	N/A	
R9 Ham Lake	?	N/A	

“0” = Neutral, “-“ = Not useful, “+” = Useful,
“0/-“ = Limited usefulness, “0/+” = Somewhat useful

Supplemental Table 4 - Weekly ICARS Cost Breakdown by Fire

Date	Aviation	Engines	Crews	Direct Personnel	Indirect Costs	Total Costs
Ahorn – Region 1						
17-Jul	\$211,431	\$14,631	\$47,500	\$138,546	\$197,481	\$618,660
24-Jul	\$689,558	\$145,041	\$197,779	\$110,500	\$670,403	\$1,870,377
31-Jul	\$918,103	\$236,261	\$481,104	\$100,170	\$921,194	\$2,779,127
7-Aug	\$584,564	\$89,248	\$364,695	\$187,833	\$1,045,692	\$2,684,931
14-Aug	\$594,784	\$144,184	\$261,752	\$144,765	\$985,337	\$2,579,328
21-Aug	\$455,617	\$218,442	\$165,041	\$135,505	\$740,873	\$1,891,343
28-Aug	\$823,864	\$68,644	\$138,896	\$83,449	\$373,212	\$1,721,012
4-Sep	\$573,073	\$159,856	\$57,763	\$89,449	\$380,569	\$1,357,955
11-Sep	\$269,854	\$159,843	\$20,929	\$76,224	\$372,416	\$989,320
18-Sep	\$103,729	\$63,339	\$1,708	\$61,041	\$365,930	\$628,880
25-Sep	\$33,149	\$0	\$0	\$17,036	\$188,891	\$248,621
2-Oct	\$21,691	\$0	\$0	\$5,732	\$97,501	\$131,221
9-Oct	\$0	\$0	\$0	\$966	\$22,189	\$29,315
16-Oct	\$0	\$0	\$0	\$597	\$20,120	\$30,112
22-Oct	\$0	\$0	\$0	\$0	\$7,615	\$20,446
TOTAL	\$4,671,112 (27%)	\$1,599,489 (9%)	\$1,737,167 (10%)	\$1,151,813 (7%)	\$6,389,423 (36%)	\$17,580,648
Rattlesnake – Region 1						
20-Jul	\$177,810	\$32,520	\$229,302	\$62,670	\$442,865	\$1,002,181
27-Jul	\$266,165	\$158,280	\$543,508	\$604,914	\$901,180	\$2,303,916
3-Aug	\$392,524	\$192,536	\$559,541	\$284,141	\$1,250,228	\$3,089,018
10-Aug	\$429,716	\$243,661	\$412,904	\$239,421	\$1,297,870	\$3,041,157
17-Aug	\$246,346	\$237,038	\$393,753	\$142,816	\$931,681	\$2,013,316
24-Aug	\$174,760	\$251,327	\$290,300	\$134,196	\$807,655	\$1,760,070
31-Aug	\$281,316	\$247,954	\$219,513	\$142,650	\$809,787	\$1,772,313
7-Sep	\$229,533	\$148,036	\$78,804	\$115,965	\$742,568	\$1,404,098
14-Sep	\$206,068	\$73,338	\$80,376	\$65,992	\$537,237	\$1,049,525
21-Sep	\$24,660	\$29,638	\$72,499	\$58,675	\$423,542	\$665,846
TOTAL	\$2,404,649 (13%)	\$1,614,328 (9%)	\$2,880,500 (16%)	\$1,851,440 (10%)	\$8,114,524 (45%)	\$18,101,440
Skyland – Region 1						
29-Jul	\$273,936	\$102,269	\$259,620	\$102,534	\$396,114	\$1,197,172
5-Aug	\$1,029,322	\$524,841	\$1,087,207	\$271,701	\$1,225,215	\$4,477,637
12-Aug	\$762,605	\$627,120	\$1,150,686	\$406,162	\$1,750,924	\$5,307,780
19-Aug	\$704,163	\$284,477	\$622,165	\$280,432	\$1,366,710	\$3,460,586
26-Aug	\$489,147	\$165,780	\$399,029	\$185,448	\$900,094	\$2,239,668
2-Sep	\$110,209	\$75,069	\$221,894	\$77,247	\$452,133	\$969,973
9-Sep	\$42,585	\$55,320	\$73,515	\$29,674	\$64,548	\$304,594
16-Sep	\$9,091	\$1,800	\$0	\$1,418	\$8,435	\$59,160
18-Sep	\$0	\$0	\$0	\$0	\$898	\$2,766
TOTAL	\$3,513,381 (19%)	\$1,836,675 (10%)	\$3,814,166 (21%)	\$1,354,616 (8%)	\$6,165,071 (34%)	\$18,019,336

Date	Aviation	Engines	Crews	Direct Personnel	Indirect Costs	Total Costs
Brush Creek – Region 1						
2-Aug	\$43,278	\$49,303	\$272,231	\$35,003	\$292,518	\$815,222
9-Aug	\$185,531	\$297,050	\$492,627	\$130,155	\$901,167	\$2,864,215
16-Aug	\$172,236	\$553,166	\$669,036	\$212,407	\$1,115,287	\$3,830,877
23-Aug	\$252,570	\$591,362	\$718,460	\$187,755	\$1,246,242	\$4,357,343
30-Aug	\$67,581	\$383,586	\$376,145	\$140,588	\$909,445	\$2,469,306
6-Sep	\$73,745	\$165,232	\$124,904	\$85,041	\$532,234	\$1,238,619
8-Sep	\$20,592	\$45,054	\$31,676	\$19,932	\$141,295	\$342,389
TOTAL	\$721,196 (5%)	\$2,084,753 (13%)	\$2,685,079 (17%)	\$810,881 (5%)	\$5,138,188 (32%)	\$15,917,971
Sawmill Complex – Region 1						
22-Jul	\$0	\$0	\$0	\$0	\$3,248	\$3,248
29-Jul	\$72,324	\$5,115	\$0	\$185	\$7,948	\$100,453
5-Aug	\$416,570	\$313,004	\$373,704	\$111,586	\$646,352	\$2,027,436
12-Aug	\$930,779	\$579,308	\$556,476	\$189,453	\$1,120,932	\$3,643,640
19-Aug	\$465,133	\$653,846	\$326,703	\$253,405	\$1,172,079	\$3,154,975
26-Aug	\$966,049	\$801,032	\$530,910	\$284,102	\$1,320,307	\$4,220,412
2-Sep	\$917,032	\$626,135	\$553,567	\$234,357	\$1,377,161	\$3,914,406
9-Sep	\$467,652	\$227,879	\$248,751	\$131,958	\$1,047,932	\$2,255,777
16-Sep	\$137,251	\$141,058	\$194,193	\$51,267	\$785,700	\$1,346,361
TOTAL	\$4,341,713 (21%)	\$3,347,377 (16%)	\$2,784,298 (13%)	\$1,256,313 (6%)	\$7,481,659 (36%)	\$20,666,708
East Zone Complex – Region 4						
17-Jul	\$168,189	\$68,378	\$96,424	\$43,249	\$310,390	\$693,478
24-Jul	\$333,001	\$407,400	\$274,445	\$151,646	\$659,147	\$1,973,478
31-Jul	\$686,112	\$516,951	\$734,662	\$281,020	\$1,418,276	\$3,767,828
7-Aug	\$927,006	\$894,415	\$1,039,942	\$390,838	\$1,622,224	\$5,018,712
14-Aug	\$1,166,178	\$671,046	\$675,649	\$372,205	\$1,429,192	\$4,506,448
21-Aug	\$568,189	\$576,154	\$446,982	\$254,636	\$1,374,174	\$3,560,997
28-Aug	\$485,024	\$498,113	\$316,953	\$265,520	\$1,391,198	\$3,325,596
4-Sep	\$317,478	\$407,681	\$253,714	\$254,893	\$1,269,527	\$2,789,998
11-Sep	\$449,307	\$371,848	\$446,628	\$320,597	\$1,312,830	\$3,087,876
18-Sep	\$352,464	\$312,311	\$614,046	\$319,419	\$1,228,396	\$2,955,508
24-Sep	\$48,369	\$45,417	\$148,626	\$72,137	\$496,810	\$829,392
TOTAL	\$5,034,088 (15%)	\$4,769,714 (15%)	\$5,048,071 (16%)	\$2,726,160 (8%)	\$12,512,164 (34%)	\$32,509,311

Date	Aviation	Engines	Crews	Direct Personnel	Indirect Costs	Total Costs
Middle Fork Complex – Region 4						
24-Jul	\$459,859	\$106,534	\$217,919	\$74,303	\$381,273	\$1,261,099
31-Jul	\$1,155,246	\$450,854	\$687,262	\$167,585	\$899,948	\$3,734,980
7-Aug	\$1,672,693	\$500,247	\$1,269,852	\$195,960	\$1,171,468	\$5,119,223
14-Aug	\$762,718	\$283,071	\$1,044,074	\$133,658	\$1,043,322	\$3,383,025
21-Aug	\$68,171	\$104,132	\$261,282	\$63,317	\$313,085	\$827,636
28-Aug	\$0	\$41,191	\$55,288	\$60,977	\$27,595	\$185,646
4-Sep	\$0	\$44,798	\$0	\$50,852	\$6,338	\$101,988
11-Sep	\$0	\$0	\$0	\$25,200	\$0	\$25,200
18-Sep	\$0	\$0	\$0	\$25,200	\$0	\$25,200
25-Sep	\$0	\$0	\$0	\$25,200	\$0	\$25,200
2-Oct	\$0	\$0	\$0	\$25,200	\$0	\$25,200
9-Oct	\$0	\$0	\$0	\$25,200	\$0	\$25,200
16-Oct	\$0	\$0	\$0	\$25,200	\$3,541	\$32,377
22-Oct	\$0	\$0	\$0	\$21,600	\$3,541	\$32,377
TOTAL	\$4,118,687 (28%)	1,530,827 (10%)	\$3,535,677 (24%)	\$919,452 (6%)	\$3,850,111 (26%)	\$14,804,351
Cascade Complex – Region 4						
23-Jul	\$41,860	\$46,026	\$86,219	\$61,521	\$444,490	\$699,027
30-Jul	\$1,417,247	\$355,613	\$600,509	\$273,296	\$1,141,141	\$3,879,809
6-Aug	\$1,693,265	\$556,337	\$1,655,641	\$389,621	\$1,626,093	\$6,033,832
13-Aug	\$1,317,580	\$760,341	\$2,383,529	\$365,691	\$1,849,964	\$6,843,816
20-Aug	\$844,300	\$939,590	\$1,786,966	\$343,056	\$1,846,237	\$5,990,289
27-Aug	\$565,201	\$812,896	\$926,271	\$299,783	\$1,267,592	\$4,135,329
3-Sep	\$519,708	\$678,496	\$712,853	\$297,074	\$909,731	\$3,253,765
10-Sep	\$397,433	\$537,510	\$1,086,486	\$295,677	\$868,146	\$3,291,704
17-Sep	\$357,953	\$580,649	\$1,406,838	\$339,308	\$1,070,924	\$3,900,246
24-Sep	\$240,497	\$264,245	\$839,906	\$251,117	\$885,546	\$2,568,368
25-Sep	\$9,412	\$4,550	\$23,637	\$16,135	\$77,377	\$137,953
TOTAL	\$7,404,456 (18%)	\$5,536,253 (14%)	\$11,987,241 (28%)	\$2,932,279 (7%)	\$11,987,241 (29%)	\$40,734,138
Landmark Complex – Region 4						
6-Aug	\$0	\$0	\$0	\$2,996	\$14,970	\$20,365
13-Aug	\$516,537	\$203,200	\$853,678	\$853,678	\$839,690	\$2,647,443
20-Aug	\$639,124	\$297,546	\$873,264	\$873,264	\$998,594	\$3,093,179
27-Aug	\$892,565	\$28,546	\$240,435	\$240,435	\$1,000,669	\$2,308,069
3-Sep	\$818,727	\$0	\$155,779	\$155,779	\$608,873	\$1,657,057
10-Sep	\$674,815	\$0	\$58,221	\$58,221	\$555,030	\$1,328,119
17-Sep	\$406,073	\$0	\$0	\$0	\$539,209	\$977,947
24-Sep	\$189,341	\$0	\$0	\$0	\$377,337	\$586,132
25-Sep	\$10,514	\$0	\$0	\$0	\$34,692	\$46,306
TOTAL	\$4,482,007 (35%)	\$529,292 (4%)	\$2,181,377 (17%)	\$540,901 (4%)	\$4,969,064 (39%)	\$12,664,617

Date	Aviation	Engines	Crews	Direct Personnel	Indirect Costs	Total Costs
Castle Rock – Region 4						
22-Aug	\$1,726,525	\$626,226	\$842,462	\$149,948	\$879,988	\$4,322,761
29-Aug	\$3,017,125	\$1,519,243	\$2,590,324	\$405,791	\$3,355,171	\$11,189,662
5-Sep	\$882,076	\$794,556	\$2,208,343	\$387,788	\$2,492,020	\$6,953,023
12-Sep	\$169,469	\$68,247	\$476,619	\$140,387	\$1,005,801	\$1,946,714
15-Sep	\$44,345	\$21,168	\$92,237	\$16,113	\$128,954	\$315,080
TOTAL	\$5,839,540 (24%)	\$3,029,440 (12%)	\$6,209,985 (25%)	\$1,100,027 (4%)	\$7,861,934 (34%)	\$24,727,240
Gray's Creek – Region 4						
5-Sep	\$1,697,539	\$275,566	\$1,341,865	\$115,630	\$1,002,820	\$4,758,081
12-Sep	\$884,518	\$338,212	\$1,720,955	\$159,409	\$1,130,121	\$4,748,661
19-Sep	\$157,122	\$221,098	\$486,485	\$37,608	\$398,783	\$1,378,569
26-Sep	\$0	\$46,005	\$0	\$0	\$15,713	\$63,302
2-Oct	\$0	\$0	\$0	\$0	\$6,618	\$6,618
TOTAL	\$2,739,179 (25%)	\$880,881 (8%)	\$3,549,305 (32%)	\$312,647 (3%)	\$2,554,055 (23%)	\$10,955,231
Angora – Region 5						
30-Jun	\$1,359,915	\$4,261,317	\$1,921,463	\$1,243,143	\$1,890,873	\$10,954,944
7-Jul	\$34,965	\$187,083	\$246,554	\$217,756	\$595,632	\$1,307,991
8-Jul	\$0	\$8,036	\$6,750	\$5,512	\$91,404	\$111,702
TOTAL	\$1,394,880 (11%)	\$4,456,439 (36%)	\$2,155,019 (17%)	\$1,466,411 (12%)	\$2,577,909 (21%)	\$12,374,637
Zaca Two – Region 5						
10-Jul	\$0	\$187,772	\$552,331	\$102,139	\$103,749	\$1,004,581
18-Jul	\$807,337	\$894,316	\$1,608,674	\$410,665	\$1,363,120	\$5,715,884
25-Jul	\$2,502,581	\$830,437	\$1,420,170	\$684,976	\$3,360,713	\$9,922,129
1-Aug	\$2,246,266	\$359,017	\$1,136,420	\$591,308	\$2,139,694	\$7,267,022
8-Aug	\$2,881,809	\$2,451,085	\$2,404,311	\$909,511	\$4,677,412	\$14,322,251
15-Aug	\$2,952,404	\$3,027,594	\$2,807,972	\$1,207,257	\$6,012,229	\$17,749,066
22-Aug	\$2,533,108	\$3,026,180	\$3,189,989	\$1,479,716	\$7,500,118	\$19,638,854
29-Aug	\$1,367,491	\$2,817,503	\$3,124,560	\$1,197,828	\$6,873,329	\$16,927,180
5-Sep	\$252,789	\$936,340	\$1,315,213	\$623,744	\$3,923,569	\$8,026,757
12-Sep	\$38,877	\$69,062	\$225,589	\$115,172	\$755,594	\$1,688,836
19-Sep	\$17,013	\$51,117	\$44,009	\$12,158	\$102,333	\$340,852
26-Sep	\$0	\$0	\$44,009	\$0	\$7,396	\$51,405
29-Sep	\$0	\$0	\$18,861	\$0	\$1,408	\$20,269
TOTAL	\$15,582,662 (15%)	\$14,650,423 (14%)	\$17,892,108 (17%)	\$7,334,474 (7%)	\$36,847,332 (36%)	\$102,649,718
Antelope Complex – Region 5 (ICARS cost data incomplete)						
11-Jul	\$858,362	\$844,617	\$1,167,975	\$247,117	\$3,016,511	\$6,417,346
14-Jul	\$138,180	\$321,138	\$318,746	\$143,526	\$1,003,526	\$2,035,243
TOTAL	\$996,542 (12%)	\$1,165,755 (14%)	\$1,486,721 (18%)	\$390,643 (5%)	\$4,020,037 (48%)	\$8,452,589

Date	Aviation	Engines	Crews	Direct Personnel	Indirect Costs	Total Costs
Elk Complex – Region 5						
17-Jul	\$756,411	\$404,946	\$1,012,728	251,114	\$1,656,422	\$4,319,322
24-Jul	\$636,634	\$604,857	\$1,503,666	473,291	\$2,298,964	\$5,940,603
25-Jul	\$73,887	\$54,779	\$194,352	64,293	\$281,902	\$733,243
TOTAL	\$1,466,932 (13%)	\$1,064,582 (10%)	\$2,710,746 (25%)	\$788,698 (7%)	\$4,237,288 (39%)	\$10,993,168
Moonlight – Region 5						
9-Sep	\$1,904,632	\$2,868,941	\$2,451,749	\$514,786	\$2,819,326	\$11,759,272
16-Sep	\$1,452,029	\$3,944,759	\$3,585,012	\$844,888	\$5,085,810	\$16,333,770
23-Sep	\$58,051	\$574,086	\$1,036,965	\$297,042	\$1,989,686	\$4,574,832
30-Sep	\$0	\$77,944	\$16,158	\$13,104	\$254,507	\$407,716
3-Oct	\$0	\$8,221	\$0	\$256	\$4,480	\$12,957
TOTAL	\$3,414,712 (10%)	\$7,473,951 (23%)	\$7,089,884 (21%)	\$1,670,076 (5%)	\$10,153,809 (31%)	\$33,088,547
Butler 2 – Region 5						
20-Sep	\$2,185,139	\$1,648,025	\$1,861,023	1,632,930	\$3,483,030	\$12,083,737
27-Sep	\$140,106	\$340,104	\$428,162	865,807	\$1,640,141	\$3,005,518
30-Sep	\$53,010	\$0	\$165,812	32,129	\$106,398	\$366,760
TOTAL	\$2,378,255 (15%)	\$1,988,129 (13%)	\$2,454,997 (16%)	\$2,530,866 (16%)	\$5,229,569 (34%)	\$15,456,015
Egley Complex – Region 6						
11-Jul	\$550,632	\$471,706	\$1,030,394	\$132,009	\$679,330	\$3,115,464
18-Jul	\$702,467	\$1,303,191	\$3,126,884	\$430,953	\$2,068,066	\$8,329,631
24-Jul	\$246,076	\$653,238	\$1,753,632	\$285,612	\$1,509,304	\$4,851,665
TOTAL	\$1,499,175 (9%)	\$2,428,135 (15%)	\$5,910,910 (36%)	\$848,574 (5%)	\$4,256,700 (26%)	\$16,296,760
Monument Complex – Region 6						
19-Jul	\$309,059	\$495,851	\$849,082	\$151,386	\$708,549	\$2,817,842
26-Jul	\$447,130	\$879,467	\$1,504,241	\$325,768	\$1,443,520	\$5,227,474
2-Aug	\$177,585	\$374,565	\$960,630	\$668,229	\$1,145,954	\$3,553,317
3-Aug	\$35,000	\$0	\$0	\$567	\$50	\$35,617
TOTAL	\$933,774 (8%)	\$1,749,883 (15%)	\$3,313,953 (28%)	\$1,145,950 (10%)	\$3,298,073 (28%)	\$11,634,250
Battle Creek Complex – Region 6						
20-Jul	\$158,720	\$179,593	\$316,266	\$69,106	\$368,621	\$1,160,836
27-Jul	\$846,406	\$582,628	\$1,440,838	\$297,933	\$1,353,821	\$4,795,640
3-Aug	\$853,535	\$545,926	\$1,876,062	\$407,480	\$1,607,125	\$5,660,228
10-Aug	\$333,796	\$218,131	\$948,196	\$239,484	\$1,082,765	\$3,037,750
TOTAL	\$2,192,457 (15%)	\$1,526,278 (10%)	\$4,581,362 (31%)	\$1,014,003 (7%)	\$4,412,332 (30%)	\$14,654,454

Date	Aviation	Engines	Crews	Direct Personnel	Indirect Costs	Total Costs
Poe Cabin						
24-Jul	\$721,055	\$139,464	\$173,011	\$75,824	\$627,203	\$1,699,699
31-Jul	\$1,434,565	\$502,557	\$705,021	\$350,019	\$1,272,523	\$3,753,557
7-Aug	\$1,450,191	\$631,613	\$752,021	\$261,212	\$1,595,771	\$4,106,553
14-Aug	\$969,650	\$541,216	\$615,340	\$160,255	\$1,206,978	\$3,071,884
21-Aug	\$610,794	\$364,863	\$550,468	\$149,050	\$1,090,966	\$2,362,008
26-Aug	\$131,554	\$30,505	\$130,018	\$15,417	\$209,648	\$404,100
TOTAL	\$2,377,533 15%	\$2,210,218 (14%)	\$2,925,879 (19%)	\$1,011,777 (7%)	\$6,003,089 (39%)	\$15,397,801
Domke Lake Complex – Region 6						
11-Aug	\$300,077	\$0	\$621,909	\$230,768	\$808,058	\$1,992,689
18-Aug	\$494,980	\$0	\$822,722	\$390,928	\$1,353,734	\$3,136,355
25-Aug	\$370,254	\$31,174	\$701,239	\$351,814	\$1,389,134	\$2,933,074
1-Sep	\$214,399	\$55,611	\$512,783	\$160,601	\$1,023,066	\$2,051,709
8-Sep	\$114,051	\$41,042	\$160,292	\$42,721	\$272,639	\$642,778
15-Sep	\$68,192	\$17,220	\$98,680	\$35,019	\$244,226	\$468,936
22-Sep	\$66,690	\$13,854	\$64,487	\$32,779	\$240,006	\$419,015
29-Sep	\$54,953	\$8,028	\$44,500	\$30,866	\$156,489	\$295,186
6-Oct	\$36,104	\$0	\$0	\$30,085	\$15,828	\$83,617
13-Oct	\$27,335	\$0	\$0	\$30,115	\$7,865	\$65,315
17-Oct	\$0	\$0	\$0	\$8,325	\$2,692	\$12,317
TOTAL	\$1,379,710 (11%)	\$166,929 (1%)	\$3,026,612 (25%)	\$1,344,021 (11%)	\$5,513,737 (46%)	\$12,100,991
Florida Bugaboo – Region 8 (DOES NOT HAVE ALL COST DATA)						
14-May	\$641,204	\$294,518	\$422,877		\$565,187	\$2,370,243
21-May	\$906,031	\$689,942	\$579,626		\$964,335	\$3,770,714
23-May	\$54,076	\$167,972	\$128,362		\$325,979	\$821,964
TOTAL	\$1,601,311 (23%)	\$1,152,432 (17%)	\$1,130,865 (16%)		\$1,855,501 (27%)	\$6,962,921
Ham Lake – Region 9						
11-May	\$1,652,625	\$508,877	\$543,063	\$168,135	\$890,151	\$3,896,202
18-May	\$1,053,825	\$673,781	\$1,135,400	\$225,638	\$1,767,549	\$5,005,974
24-May	\$28,581	\$0	\$0	\$84,931	\$1,512,070	\$2,114,979
TOTAL	\$3,788,856 (34%)	\$1,182,658 (11%)	\$1,678,463 (15%)	\$478,704 (4%)	\$4,169,770 (38%)	\$11,017,155

Date	Aviation	Engines	Crews	Direct Personnel	Indirect Costs	Total Costs
Big Turnaround Complex – Okefenokee Wildlife Refuge, US Fish and Wildlife Service						
22-Apr	\$83,165	\$59,777	\$0	\$182,967	\$270,439	\$498,500
29-Apr	\$323,393	\$213,963	\$60,307	\$316,703	\$623,483	\$1,515,965
6-May	\$443,834	\$315,190	\$119,082	\$429,633	\$883,778	\$2,361,844
13-May	\$1,027,959	\$578,091	\$210,172	\$437,404	\$1,382,708	\$4,456,975
20-May	\$1,014,421	\$640,158	\$404,612	\$854,311	\$1,764,203	\$5,113,756
27-May	\$840,182	\$614,966	\$445,823	\$1,058,983	\$1,566,884	\$4,291,420
3-Jun	\$887,694	\$492,641	\$304,100	\$699,248	\$1,458,043	\$3,859,130
10-Jun	\$829,725	\$436,199	\$73,000	\$593,744	\$1,264,295	\$3,299,343
17-Jun	\$452,775	\$238,381	\$0	\$361,632	\$1,062,607	\$2,325,938
24-Jun	\$27,982	\$20,967	\$0	\$179,629	\$122,907	\$240,134
1-Jul	\$0	\$313	\$0	\$72,440	\$16,094	\$16,406
8-Jul	\$0	\$1,371	\$0	\$10,245	\$5,680	\$7,051
TOTAL	\$5,930,265 (21%)	\$3,608,304 (13%)	\$1,617,096 (6%)	\$5,197,771 (19%)	\$10,294,208 (37%)	\$27,986,462
WSA Lightning Complex – Warm Springs, BIA						
18-Jul	\$341,182	\$266,862	\$415,467	\$81,931	\$667,299	\$1,938,696
25-Jul	\$534,082	\$442,488	\$822,884	\$281,254	\$1,090,786	\$3,474,253
1-Aug	\$390,004	\$357,604	\$597,048	\$210,604	\$905,911	\$2,680,311
8-Aug	\$421,602	\$286,440	\$910,517	\$201,127	\$931,986	\$2,950,634
15-Aug	\$855,934	\$516,361	\$1,575,058	\$356,526	\$1,191,939	\$4,894,082
22-Aug	\$271,817	\$363,452	\$1,204,205	\$247,975	\$1,036,296	\$3,385,293
23-Aug	\$10,938	\$11,124	\$47,515	\$5,113	\$78,258	\$160,841
TOTAL	\$2,825,559 (14%)	\$2,244,331 (12%)	\$5,572,694 (29%)	\$1,384,530 (7%)	\$5,902,475 (30%)	\$19,484,110
Murphy Complex – BLM						
22-Jul	\$330,554	\$412,494	\$388,688	\$103,401	\$576,138	\$2,028,997
29-Jul	\$511,024	\$1,670,960	\$1,425,405	\$298,180	\$2,712,216	\$7,282,166
5-Aug	\$0	\$260,258	\$190,129	\$117,260	\$562,040	\$1,240,448
TOTAL	\$841,578 (8%)	\$2,343,712 (22%)	\$2,004,222 (19%)	\$518,841 (5%)	\$3,850,394 (36%)	\$10,551,611

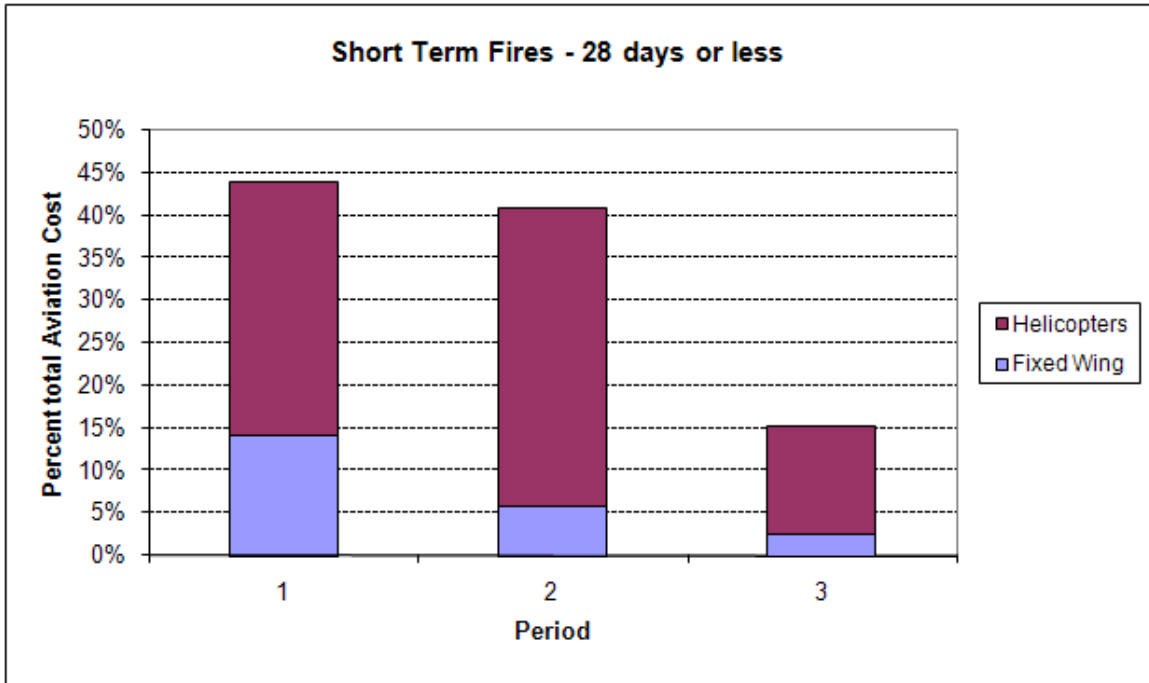
*Total costs in this table may not align exactly with the total costs in Table 1 due to inconsistent reporting of the final ICARS costs.

Supplemental Table 5 – Fire Costs within Fire Duration Categories

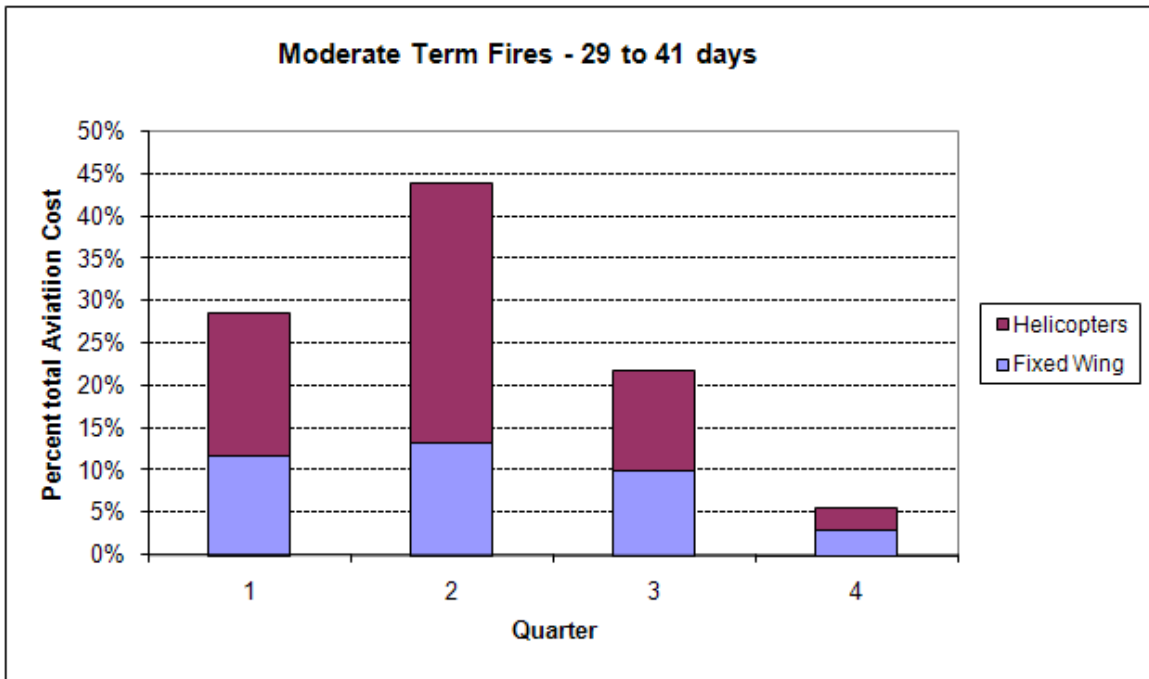
Term	Fire Name	Breakdown of Major Fire Costs (percent of total cost)					Total Costs (\$ million)
		Aviation	Engines	Crews	Direct Personnel	Indirect Costs	
Short	Angora	11	36	17	12	21	12.3
	Antelope Complex	12	14	18	5	48	10.7
	Butler 2	15	13	16	16	34	15.4
	Landmark Complex	35	4	17	4	39	12.7
	Grays Creek	25	8	32	3	23	10.9
	Murphy Complex	8	22	19	5	36	10.6
	Egley Complex	9	15	36	5	26	16.3
	Ham Lake	34	11	15	4	38	11.0
	Monument Complex	8	15	28	10	28	11.6
	Moonlight	10	23	21	5	31	33.1
	Elk Complex	13	10	25	7	39	18.3
	Domke Lake Complex	11	1	25	11	46	12.1
	Battle Creek Complex	15	10	31	7	30	14.6
	Mean	16	14	23	7	34	14.8
Standard Deviation	9	9	7	4	8		
Moderate	Castle Rock	24	12	25	4	34	20.7
	Middle Fork Complex	28	10	24	6	26	24.7
	Florida Bugaboo	23	17	16		27	12.4
	Brush Creek	5	13	17	5	32	15.9
	Poe Cabin	15	14	19	7	39	15.4
	Mean	19	13	20	6	32	17.8
Standard Deviation	9	3	4	1	5		
Long	WSA Lightning Complex	14	12	29	7	30	19.5
	Skyland	19	10	21	8	34	18.0
	Sawmill Complex	21	16	13	6	36	20.7
	Zaca Two	15	14	17	7	36	102.7
	Ahorn	27	9	10	7	36	17.6
	Big Turnaround Complex	21	13	6	19	37	32.5
	Rattlesnake	13	9	16	10	45	18.0
	Cascade Complex	18	14	28	7	29	40.7
	East Zone Complex	15	15	16	8	34	32.5
	Mean	18	12	17	9	35	33.6
Standard Deviation	4	3	8	4	5		

Supplemental Figure 1. Aviation Costs for Each Fire Duration Category

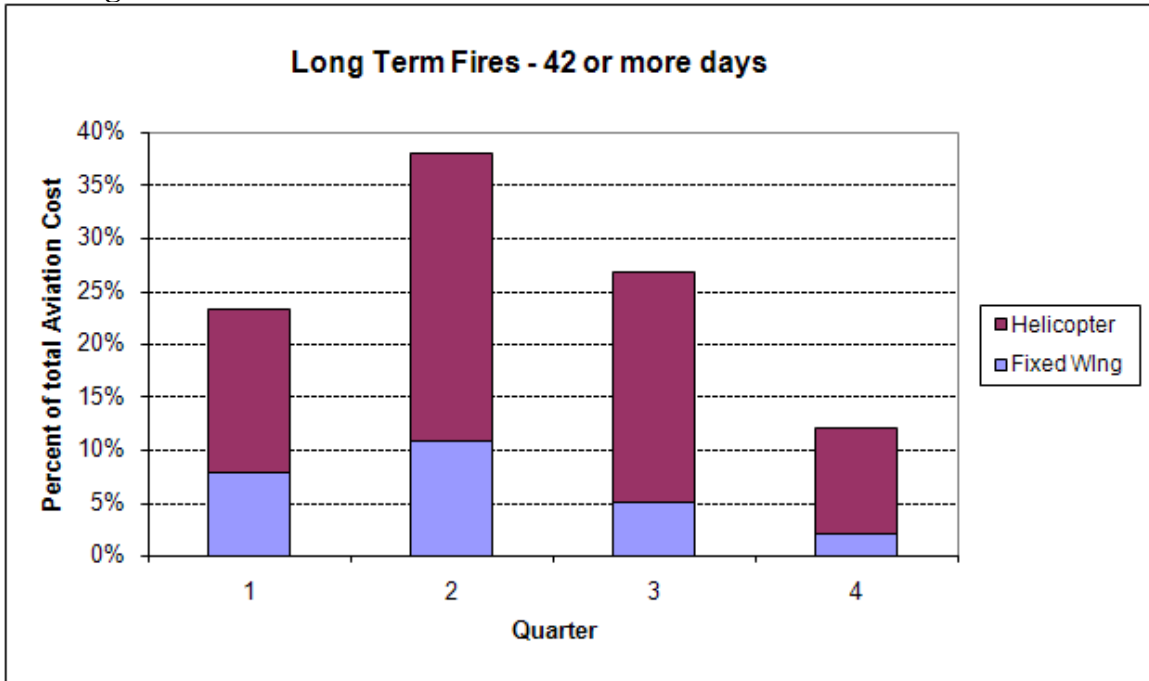
1a. Short Term Duration Fires



1b. Moderate Term Duration Fires



1c. Long Term Duration Fires



Panel Bios

Mr. Arthur “Butch” Blazer, Director
State of New Mexico Forestry Division
1220 South St. Francis Drive
Santa Fe, NM

Mr. Blazer serves as the Director of the State Forestry Division of the State of New Mexico’s Energy, Minerals and Natural Resources Department. A member of the Mescalero Apache Tribe and a 1975 graduate of New Mexico State University, with a B.S., Butch is the first Native American to have been appointed as “State Forester” for New Mexico.

Mr. Blazer brings to New Mexico State Government a rich natural resources background, stemming from over 27 years of experience in working with federal and tribal natural resources management programs across the country. In 1983, Butch helped co-found the Native American Fish & Wildlife Society, a non-profit, national organization established to assist Tribes and Alaskan Villages establish and maintain viable natural resource management programs on their respective tribal lands. He served as national President of this organization from 1996-2000.

In 2001, Mr. Blazer was appointed and served two 3-year terms on the National Advisory Council for Environmental Policy & Technology (NACEPT), a committee that provides input and advice to the Director of the Environmental Protection Agency (EPA) concerning national environmental issues and concerns. In 2005, he was appointed to serve a three year term with the national Biomass Research and Development Technical Advisory Committee, a committee co-sponsored by the Departments of Energy and Agriculture, to carry out the tasks identified in the Biomass Research and Development Act of 2000.

Dr. Sharon Caudle

Bush School of Government
Texas A & M University
College Station, TX

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.

Mr. Richard (Rick) E. Clevette

10088 Island View Close
Chemainus, British Columbia
Canada

Mr. Clevette holds a diploma in Forest Resource Technology and has various certificates and recognitions from extension and governmental in-house training programs. He has over 32 years with the British Columbia Ministry of Forests; the last 15 with the Protection Program as the provincial Manager, Fire Management. As well as managing the suppression/operations program, he was responsible for interagency and corporate liaison at the provincial, national and international level. During his protection tenure, Mr. Clevette was instrumental in drafting and implementing the British Columbia Emergency Response Management System (based on ICS principles), the Northwest Fire Compact and new stand-alone Wildfire legislation.

Mr. Clevette has also chaired many national and international wildfire associations including the Canadian Committee on Forest Fire Management, the Canadian Interagency Forest Fire Center, Western Fire and the Northwest Fire Council. He also chaired the 2nd International Wildland Fire Conference held in Vancouver in 1997.

As the provincial fire program manager, Mr. Clevette was an invited participant on a 5 week fire management study tour of Australia and New Zealand. He has participated in numerous United Nations sponsored summits and study sessions relating to all aspects of wildland fire management. He retired in 2003 and currently provides consultant services to the provincial government, the forest industry and utility companies on fire management and fire prevention issues. He is also working with local and regional governments on community wildfire protection plans.

Dr. John R. Shelly

Cooperative Extension Advisor
University of California
Berkeley, CA

Dr. John Shelly is a Wood Scientist and Cooperative Extension Advisor in Biomass and Forest Product Utilization at the University of California at Berkeley. He is recognized nationally for his expertise in woody biomass utilization. He also specializes in the physical properties of wood and manufacturing technology. Recent research efforts involve analyzing the basic properties and commercial availability of biomass resources, including wood, from wildland/urban interface and intermix tree removals, fuels reduction efforts, forest thinning, and drought and beetle-induced mortality. Current research projects are focused on the technology needed to wisely use these underutilized resources to enhance forest health and economic development. These include leading major projects on the utilization of diseased wood in the coastal urban interface regions of central and northern California inflicted by the Sudden Oak Death disease; and, of dead and dying trees in the drought-stressed, beetle-infested forests of southern California.

Dr. Shelly teaches forest products at the University of California and workshops in woody biomass utilization throughout California. Dr. Shelly serves on the Board of the California Biomass Collaborative and is the regional representative for the National Sun Grant initiative funded by the US Department of Transportation. He previously served on the faculty at the University of Kentucky.

Dr. Shelly earned his masters and doctorate in Wood Science and Technology from the University of California at Berkeley. He is current chair of the Northern California section of the Forest Products Society, past Regional Board Member of the International Forest Products Society, and a member of the Society of Wood Technology.

Mr. Thomas S. Szayna

Senior Political Scientist
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Mr. Szayna's research has focused on aspects of strategic planning for the U.S. armed forces, post-conflict stability and reconstruction operations, and coalition interoperability. He is the principal investigator of the project that led to the design of SAFE (Stability Army Operations Force Estimator), a computer application for planners to estimate the size and structure of forces required for post-conflict stability and reconstruction operations. He has testified before the United States House of Representatives and has been a keynote speaker at a number of defense conferences.

Some of his recent RAND monographs are: Preparing the Army for Stability Operations: Doctrinal and Interagency Issues, The Civil-Military Gap in the United States: Does It Exist, Why, and Does It Matter?, Improving the Planning and Management of U.S. Army Security Cooperation, NATO Enlargement 2000-2015: Determinants and Implications for Defense Planning and Shaping, The Emergence of Peer Competitors: A Framework for Analysis, and Identifying Potential Ethnic Conflict: Application of a Process Model.

Panel Review Project Manager

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Dr. Hyde's academic career includes serving as a visiting professor at the American University's Department of Public Administration, in Washington, D.C. (1992-1996). He was the chair of the Policy and Public Management Departments at the University of Pittsburgh (1988-1991) and at San Francisco State University (1984-1988), and has held faculty appointments at the University of Colorado at Denver and the University of Houston-Clear Lake. Before beginning his academic career, he was a foreign service officer in the U.S. Department of State and a senior associate with the New York State Legislative Commission on Expenditure Review.

Dr. Hyde is the author or editor of six textbooks including Classics of Public Administration (6th Edition in progress), Personnel Management in Government (5th Edition) and Government Budgeting (3rd Edition). He has written widely on all aspects of management and administration.

Dr. Hyde received his Ph.D. in political science from the State University of New York at Albany in 1980.

The Panel fully supports the strategic “what if” suggestion provided by Tom Szayna, one of Panel members, and introduced in the main body of the report. A fuller description of the concept follows in keeping with the Panel’s task of providing an external perspective on informed risk management. The section below was written by Mr Szayna and should be attributed to him.

Appendix A

Strategic Thinking on Fire Management Risk & Cost Issues

By Thomas S. Szayna

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A strategy change, from perimeter to point protection, can lead to cost savings, if combined with organizational changes and proper integration of technology to make the strategy work. The following elements seem essential to achieving that goal:

- 1) Full understanding of capabilities and their costs;
- 2) Good situational awareness and confidence in accuracy of forecasts;
- 3) Flexibility in use of resources, meaning modularity, so as to allow graduated response;
- 4) Tools that provide real-time decision support & link all of the above elements together.

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The tools (in point 4) must be reliable and trusted by implementers, that reliability and trust will lead to long-term behavior modification and different mentality, away from hoarding resources and to willingness to part with them temporarily – that’s where the cost savings from strategy change will come into play. The tools must allow for “smart” decision-taking; not take away the deep knowledge of ICs but to improve their ability to make more informed choices. Based on the discussions during the site visits, it seems clear that people on the ground are skeptical of a tool will take away their decision-making ability and degrade their experience and expertise.

To illustrate the change in mentality, consider an analogy with the military. In the Gulf War 1990-91, “mountains of iron” were sent to Saudi Arabia because of the mentality that there was never enough in conditions of high risk and deep uncertainty. Contrast that with current operations and the military’s “just in time” approach that emphasizes high confidence in delivery of items, and diminishes the tendency to over-order and hoard and thus waste.

What seems in order is a combination of a strategy change, organizational changes, and introduction of specific technologies. A strategy change by itself seems unlikely to achieve the desired cost savings. Put in a different way, if the costs of perimeter control stem from using high cost assets (i.e., full effort by Type 1 team to contain a fire), and point protection may mean some assets on call to protect specific points if threatened, then using expensive assets (i.e. Type 2 team) to monitor the fire for months means poor adaptation to new strategy. End result is that overall costs are not all that different. A more efficient use of resources would mean using parts of Type 2 team to intervene, as needed, and with need determined (and uncertainty reduced) by better forecasting and optimization tools.

The four main points are discussed in more detail below.

Full understanding of capabilities and their costs.

This entails working out detailed planning factors for all assets to inform calculations of tradeoffs. For example, for sub-units within a Type 1 team, how many miles of fire break can they construct (varying on the basis of type of terrain, weather conditions, crew exhaustion state, etc.). If done for all assets, such calculations would allow a comparison of how much incremental change – adding two bulldozers and crews – adds to the output. In other words, building blocks of information are needed to understand under what circumstances would more of X be a more efficient answer than use of Y? It would be easy to construct a tool that automatically calculates the substitutability of assets (as in aviation vs. component of Team 1). The military uses such tools.

The workloads are needed to be done for aviation assets too. To focus on aviation (as one part of the larger picture), there is a need for a methodical assessment of what aviation brings to the table and where the tradeoffs are in the use of aviation. Potential dimensions for analysis of aviation efficiency might include:

- 1) Step by step assessment of where aviation capabilities are unique (i.e., no easy counterpart or substitute by ground assets); this could be tied to rapid response to channel and/or prevent spread of fire (ex: IA in severe terrain, reaction to sudden shifts in wind) or specific tactics (delay the further spread and wait for season-ending event). In those cases, assess the direct costs (aircraft, fuel, crews, retardant, O&M).
- 2) Similar assessment of areas where aviation capabilities are not unique (i.e., a regional commander might choose to deploy either aerial or ground assets). Awareness of costs then will drive decisions on which assets – if both are available -- are more cost-efficient. The basic question to ask is: what is the need (elaboration of feasible tasks), and where does it have unique or case-specific advantages?

Good situational awareness and confidence in accuracy of forecasts.

Efficient use of assets stems from an accurate assessment of the situation and understanding the potential threat. There are several components to this point. They include the following:

- 1) Real-time situational awareness of fire progression, continuously updated (day & night, use of UAVs with infra-red sensors). The analogy with the military is the way that a headquarters functions; some staff is always on duty and continuously receive information and monitor the area of responsibility for surprises and enemy movement. Information that may be of importance is passed to acting commander at once, resulting in tactical adaptation. There is work in the military realm that has quantified the value of information;⁶ the same is possible in relation to wildfires.
- 2) Conceptual understanding of fire behavior. Improve existing fire behavior models and adapt to local conditions, include continuously-updated weather data (real-time feed and historical patterns), local topography, fuels presence.
- 3) If points 1 & 2 outlined above are in place, the result may be a reliable forecast of fire spread, automatically presented in geospatial format that includes progress by time (days) and with confidence levels. The confidence levels are necessary for risk assessment (developed further in the main point 4 below). The assumption is based on the principle that predictive power diminishes as time horizon expands (i.e., there is very high confidence for 1 day forecast, high confidence for 3 days, moderate confidence for 7 days, and so on). The point is to include uncertainty in all calculations (assign numerical values to extent of uncertainty) and work with it. These values could be assessed in historical validation exercises.

Flexibility in use of resources, meaning modularity, so as to allow graduated response.

Stemming from point 1 above, once the capabilities are understood, allowing for calculations of tradeoffs and savings, there is a need to have the flexibility to use just what is needed. While some force packaging is to be expected, some organizational changes may be necessary to allow flexibility (i.e., parts of Type 1 or Type 2 teams to deploy independently). In general, some kind of modularity is essential, and structuring sub-Type 1 or Type 2 team detachments needs to be informed by workloads and usefulness of independent action.

There is a clear analogy with the military, especially with the Army, in that a battalion from one brigade can be detached to another brigade at will. Everyone (at battalion and brigade levels) operates on the basis of standard operating procedures and rules.

Tools that provide real-time decision support & link all of the above elements together.

This point links steps 1-3 together. To reiterate, the three points are:

⁶ Richard E. Darilek, Walt L. Perry, Jerome Bracken, John Gordon, Brian Nichiporuk, *Measures of Effectiveness for the Information-Age Army*, MR-1155-A, RAND, 2001.

- Understanding of workloads/capabilities, costs and benefits and tradeoffs;
- Good situational awareness and confidence in forecasts;
- Flexibility and agility in organization (use what you need, not what you have).

There is a need for an integrated tool that would link forecasts & expectations with capabilities and properly organized and flexible units, to inform the judgment of a local commander on the course of action if the commander chooses to optimize in a certain fashion. The goal is not to take away a commander's wisdom and insight acquired over 20 years, but to give her/him the best informed set of options on which to base his/her decisions.

The above means a portfolio-based strategy,⁷ based on assessment of the mission goals and the values at risk. The disparate values at risk should not be just added up. Instead, they need to allow to optimize wisely, across scenarios, for example, allowing for "minimizing maximum regret," with regret levels set at different levels for different types of assets (i.e., reduce possibility of high-value residences being burned down to negligible level, such as 1%, but take a greater risk, say 20%, of fire spreading into nearby protected wildlife sanctuary). Optimization in such a fashion might mean several sub-Type 1 or 2 team detachments in place, with aviation assets and full complement of Type 1 or 2 team on call within, say 3 days. The assets on call would be available for another contingency, if it arose. The tools suggested above would provide input at both the level of informing choices of strategy and specific tactics.

What is called for is not a simplistic optimization tool with one answer. The commander needs to make the call, but he should have the ability to fully understand the choices and options. That means a tool that runs quickly (in minutes if not seconds) and can provide a variety of forecasts based on differences in what values are to be protected and what risks the local commander is willing to tolerate. Robustness across potential scenarios would be the general goal.⁸ The tool would give the commander the comfort zone that, even if conditions change, due to fundamental uncertainty and risk, he will have already planned for those risks (accurate fire behavior models and good situational awareness) and have assets on call (confidence that the assets will be delivered). This will result in learning to live without everything in place, such as a Type 2 team watching the fire burn for months.

The gist of all this is: Give the commanders tools that work, as well as flexibility and graduated response, and behavior modification will follow, away from hoarding and waste and in favor of more efficient use of resources.

⁷ Paul K. Davis, Russell D. Shaver, Justin Beck, *Portfolio-Analysis Methods for Assessing Capability Options*, MG-662-OSD, RAND, .2008

⁸ Robert J.Lempert, Myles T. Collins, "Managing the Risk of Uncertain Threshold Responses: Comparison of Robust, Optimum, and Precautionary Approaches," *Risk Analysis*, 27:4 (2007), 1009-1026.

In order to accomplish the above blueprint, there is a need for some upfront outlays of funds. This would be a strategic investment that potentially would lead to large cost savings, as it would allow for an effective change of strategy. A justification for the upfront costs is the very real prospect of long-term trend of escalating costs because of new weather patterns and likelihood of large fires in 2010 and beyond.

There is a need to portray the costs of these fires in a different format. Rather than a focus on presenting the direct costs (federal department level), there is a need to present all the indirect and societal costs of the incidence of large fires, including economic opportunity costs (local communities, tax revenues) and health care costs (long-term respiratory disease incidence). Just because the Department of Agriculture or Interior doesn't pay for something doesn't mean that the U.S. society does not pay for it. There is also a rationale for placing such costs in terms of Homeland Security concerns.

Finally, in putting together the tools described above, there is a great deal of existing tools the military uses that can be adapted for use in fighting wildfires. For decades, there has been research at the National Laboratories (Los Alamos, Livermore, Sandia) on the contours of WMD plume spread. The physics behind this work may be applicable to fire behavior. The military also has a great deal of modeling and simulation expertise, and the tools that battle labs use may be applicable to simulation of containing wildfires. Both the private sector (especially aviation) and the military have highly sophisticated tools that forecast a multitude of options and risks associated with them. There are also portfolio and optimization tools designed at research institutes (including RAND) that could be adapted easily for purposes of dealing with wildfires.

The Panel fully supports the extended assessment provided by Panel member Sharon Caudle provided in this Appendix. A fuller description of the concept follows in keeping with the Panel's task of providing an external perspective on informed risk management. The section below was written by Dr Caudle and should be attributed to her

Appendix B

Effectively Targeting Large Fire External Reviews

By Dr. Sharon Caudle

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Introduction

By design, large, complex, and costly fires are subject to several different types and levels of review, both internal and external. External reviews include a Chief's Principal Representative Review, a regional large fire cost review, and a national independent panel review. In addition, there are many other reviews, mostly internal, including forester reviews, after action reports, and cost and financial reviews during the course of the fire. These reviews are designed to be independent of each other and not integrated into a comprehensive external review strategy and related process.

Because of review selection criteria, such as cost thresholds, larger fires will be subject to at least three external reviews with generally similar objectives. The Panel was asked to examine the regional large fire cost review process and outcomes and what a national review should assess. To provide a more comprehensive picture, the Panel also examined the Chief's Principal Representative Reviews.

Under Forest Service guidance, the Chief's Principal Representative and the related team is to provide a national perspective concerning each fire of national significance and how it fits within the overall fire situation. The CPR is to consider if strategies dealing with the fire were commensurate with the values at risk locally, regionally, and nationally. Values at risk regionally and nationally were defined by needs beyond the scope of the immediate incident, including assessing the opportunity cost of assigning resources to the incident in question rather than a competing regional or national incident. The CPR methodology is to include (1) reviewing documents such as the Land Management Plan, Fire Management Plan, Wildland Fire Situation Analysis, and Delegation of Authority concerning their alignment; (2) reviewing documents from the Wildland Fire Decision Support System used in the planning process; (3) providing a final narrative to include decisions and significant events, a discussion regarding alignment of strategic documents, cost management decisions, incident trends, and a rationale for actions; and (4) conducting an after action review on the CPR process.

A second major external review is a Regional Large Fire Cost Review. Forest Service May 2007 guidance, also apparently utilized by the Department of Interior, provides specific direction for these reviews of fires costing over \$5.0 million. The objective of the review is to determine if resources including funds, equipment and people were used appropriately to identify areas for more effective and efficient future wildfire suppression. Sub-objectives include assessing the availability of sufficient and reliable information for decision-making; socio-political issues and related costs; risk management approaches; and operational decision-making. Each review is to include (1) an executive summary providing highlights of the report, (2) a summary of each fire in the region being reviewed, (3) an expenditure analysis, (4) findings including best practices and areas for improvement regarding sufficient and reliable information, social-political factors, risk management, and tactical (operational) decisions, and (5) recommendations. These regional reviews are termed performance audits. The May 2007 guidance provides specific information on how a performance audit should be conducted, including planning, obtaining sufficient and appropriate evidence to provide a reasonable basis for findings and conclusions, and developing a finding. For example, the methodology includes site visits. Teams must interview the Agency Administrator, the Incident Commander, any other IMT members deemed necessary, and a community opinion leader. Documentation is also to be gathered.

In addition, since 2004, there has been a Secretary of Agriculture requirement for an Independent Review Panel (Panel) to review all wildland fires that exceed \$10 million in costs. This national review is in addition to the CPR reviews and the regionally required review for all fires that exceed \$5 million in costs. The purpose of the Panel review recently has been twofold. One has been to determine if the Forest Service exercised fiscal diligence in managing specific incident suppressing activities. The Panel focuses on strategic decisions and actions, compliance with policy and law, and risk analysis and management. Second, the Panel's review addresses cross-cutting cost management issues and potential strategies that could impact fire suppression costs at strategic levels. The Panel's methodology included document reviews, site visits, and extensive interviews. For example, in reviewing the 2006 large wildfire costs, the Panel conducted site visits on 16 forests where the fires occurred. These site visits featured strategic discussions of pre-fire conditions, the fire chronology and suppression actions and results, and assessment of cost management and fire outcomes.

External Oversight Findings and Recommendations

In considering the value and options for external oversight reviews, the 2007 Panel first gathered information from discussions with personnel involved in the fires costing over \$10 million. Second, the Panel used the guidance for the CPR, regional, and independent national reviews to contrast various features of the reviews, such as purpose and review coverage. Third, the Panel reviewed those final and draft CPR and regional review reports provided to it to assess their overall focus and approach, observations and conclusions, and recommendations. Lastly, based on the findings of its assessment of the reports, the Panel developed an alternative model and methodology for external oversight reviews based on its discussions with personnel and its review of actual reports, and

recommends better review integration with agency strategic planning and program evaluations.

Site Visit and Interview Observations

During its site visits and telephone interviews, the Panel asked about the methodology used in the CPR and regional reviews, the usefulness of the review process and report for future improvements, and suggestions to improve the external oversight approach. While those interviewed believed there was merit in external reviews, they did voice several concerns with CPR and regional review conclusions, methodology, and reporting. The following summarizes what the Panel was most often told during its visits and interviews.

CPR External Review

- The CPR tended not to have fire experience and the time at the fire was often considered an educational or training experience for Washington Office personnel, not a review of fire management decisions and significant fire events.
- It was not clear across all the fires what role the CPR was to play at the fire: Provide consultation or coaching? Represent the Chief in validating fire management decisions? Negotiate for additional resources on the fire? Collect information on costs and/or operations for better practices at subsequent fires?
- In some cases, the CPR spent very little time at the fire due to other primary work responsibilities (regional foresters); it was unclear how comprehensive or robust the resulting report might be.
- Often, the CPR observations and recommendations did not provide additional insights into problem areas, possible causes, and options for future improvement.
- In some cases, the CPR report was not provided to the region or forest personnel for action.

Regional External Reviews

- The scope of the review, while apparently both strategic and operational, heavily emphasized operational issues, and those primarily were process issues that were very insignificant in impacting the cost of the fire.
- In some cases, the regional review did not include a site visit or telephone interviews. Instead, the review performed document reviews, not allowing a dialogue regarding fire management approaches and events not readily captured in documents.
- In some cases, review personnel were not familiar with cost issues and cost sharing agreements in the region, leading to what was described as flawed observations and recommendations.
- In some cases, there was not sufficient detail for corrective action, including a clear description of the problem condition the reviewers found, what was the direct cause of the problem, and what was the direct effect of the problem. Those interviewed generally did not find the reviews helpful in suggesting improvements to reduce costs.
- Regions and forests did not often have an opportunity to review draft reports to correct factual errors or provide content that would better explain fire events and decisions.

- Final regional review reports were, in some cases, not shared with the region or forest responsible for the individual fires, or with other regions regarding better practices.
- In some cases, the CPR review did not have the same observations or findings as the regional review, even though both appeared to cover the same content in the same level of detail.

The Panel also was told that the individual oversight reviews should not overlap if they remain as separate reviews. There should be clear selection criteria and different review areas for each. For example, it was observed that one review might cover national policy problems and options while another could focus on operational issues such as the use of tools and technologies and the staging of teams. Further, the participants noted that these external oversight reviews should be done more “in real time” or immediately after any fire so there is a better understanding of the fire context, decision space, and options at a point in time. Participants also were concerned that many of the review reports were not issued until very recently or remain in draft form, making it difficult to take corrective action well in advance of the new fire season.

Formal Guidance: Oversight Review Features

The Panel used the formal guidance for the CPR, regional, and independent national reviews to contrast various features of the reviews, such as purpose and review coverage. As Table 1 summarizes, the three major external reviews all have similar purposes and coverage of fire management and cost management decisions.

Table 1. Planned Elements of Large Fire Reviews

Elements	CPR	Regional Large Fire Cost	2007 Independent Panel
Primary Review Purpose/ Objective	Appropriate fire strategies for local, regional, and national values at risk	Appropriate resource (funds, equipment, and people) use	Determine if the Forest Service exercised fiscal diligence in managing specific incident suppressing activities.
Cost Threshold per Fire	Not specified; are fires of national significance	\$5 million	\$10 million
Formal Review Standards	Not applicable	Generally Accepted Government Auditing Standards	Not applicable
Review Timing	During the fire	After the fire	After the fire
Reporting	Narrative to the Chief, OMB, Regional Forester or Representative, AA, IMT, Lessons Learned Center	Draft report to the WO; peer review with another review; final report to the WO	Report to the Secretary of Agriculture
Review Coverage			
Public information	<i>Public information needs and provision</i>	<i>Not specified</i>	<i>Not specified</i>
Resource management	<i>Expectations for the National Multi-Agency Coordination group</i>	<i>Resource availability, capability, or efficiency impact on tactical decisions, size, and/or final cost of the fire</i>	<i>Strategic decisions and actions Compliance with policy and law Risk analysis and management</i>

Elements	CPR	Regional Large Fire Cost	2007 Independent Panel
	<i>Suppression resource management options</i>	<i>Socio-political factors impact on actions and costs</i> <i>IMT and AA actions to control personnel, contracts, and aircraft costs</i> <i>IMT action impact on overall fire costs</i>	<i>Cross-cutting cost management issues</i> <i>Potential strategies impacting strategic fire suppression costs</i>
Post-incident support	<i>Post incident support needs regarding risk sharing</i>	<i>Not specified</i>	<i>Not specified</i>
Cost and risk sharing	<i>Cost agreements and cost recovery potential</i>	<i>Risk sharing with general public, local, state, and federal agencies</i>	<i>Collaborative cost management strategy</i>
Forest and IMT decision processes	<i>Fire cost relationship to forest and IMT strategic decisions</i>	<i>Necessary information for line officers and ICs to make timely and prudent decisions</i> <i>DOA containing direction for clear protection and cost containment guidance</i> <i>Threat level identification and balancing with acceptable costs</i> <i>Decision quantification to manage threats</i> <i>AA direction fire cost impact</i>	<i>Strategic decisions and actions</i> <i>Compliance with policy and law</i> <i>Risk analysis and management</i> <i>Cross-cutting cost management issues</i> <i>Potential strategies impacting strategic fire suppression costs</i>
LMP, FMP, WFS, and DOA alignment	<i>Alignment of the LMP, FMP, WFS, and DOA</i> <i>WFS process collaboration level</i>	<i>LMP and FMP linkage and direction for suppression strategies</i> <i>Values at risk</i>	<i>LMP coverage of fuels reduction activities, WUI changes, climate change and forest health impacts, and fire history</i> <i>FMP strategic assessment of fire management planning and policies</i> <i>WFS process collaboration level</i> <i>DOA statements outlining larger suppression objectives, resource values and final restoration concerns, and expectations about containing fire cost growth</i>
Performance measures	<i>Performance measures for suppression, cost management, and safety</i>	<i>Not specified</i>	<i>Not specified</i>
Incident trigger point decisions	<i>IMT flexibility, scalability, and timing</i> <i>Short and long term suppression cost management</i>	<i>Not specified</i>	<i>IMT agility and adaptability for selective deployment capability</i> <i>Short term and longer term cost plans for fire resource ordering and procurement</i>

Elements	CPR	Regional Large Fire Cost	2007 Independent Panel
			<i>Short term and long term management options of suppression resources</i> <i>Type III IMTs and state and local resources in incident close out</i> <i>IMT commitment to prolonged large fire operations.</i>

In general, these three strategic reviews begin with individual fires as their primary unit of analysis but cover much the same content ground as they develop observations or findings, and then developing conclusions or recommendations. With the exception of the CPR review, the reviews generally assess decisions and costs for the duration of the fire, but perform the review after the fire event is over. The CPR review operates more in “real time” as fire management decisions are made. It is intended to provide a forward look at expected national and regional resources and challenges for the remainder of the fire season. The other two reviews are designed to be considerably more robust in the methodology and report content and occur after the fire, often many months after.

While the scope of each review differs, all three are intended to cover operational and strategic level findings based on their unit of analysis, with the CPR reviews tending more toward operational aspects and the nation review tending more toward strategic aspects. The CPR report provides observations basically limited to the fire under review. The regional large fire cost reviews also assess individual fires, and then draw individual fire and regional observations and develop recommendations. The independent panel review primarily uses individual fire observations to develop national, cross-cutting recommendations.

Alternative Model for External Oversight Reviews

Based on its discussions with personnel and its review of actual reports and their weaknesses an alternative external oversight model of reviews should be considered. Such a model should ensure an integrated review approach that would build an evaluative framework from individual fires to national strategies. The model would establish possible cost thresholds to differentiate what fires might be subject to regional and national independent reviews (such as \$10 million and \$15 million respectively). The new model would still use external review entities such as the CPR and the independent panel, but would remove the current duplication and overlap across the reviews and provide an integrated hierarchy of oversight. However, the cost threshold and who conducts the reviews are not nearly as important as *what is to be reviewed and for what decisional time period.*

The Panel’s proposed oversight model emphasizes two major review perspectives. One would be to differentiate individual fire management and resulting recommendations into three decision spaces: 1) preparedness and capabilities before the fire, 2) fire management during the term of the fire, and 3) any post-fire management lessons learned (or unlearned) and better practices for the next fire season. The Panel’s reviews of fires

in 2006 and 2007 and the CPR and regional reviews for 2007 indicate that many of the issues driving costs clearly can be separated in at least these three decision space time frames. 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.

A second perspective would be 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, the use of decision support tools and technologies during the fire. Table 2 provides an overview of this alternative model and examples of coverage.

Table 2. Oversight Review Model

Decision Focus	Pre-Fire (Preparedness)	Fire Event (Response)	Post-Fire (Better Practices)
Fire Review Selection Criteria	None: unit of analysis national forests to mitigate fire cost potential	Immediately after the end of the fire: All fires over \$10 million in cost and those long-term large fires where costs appeared contained	All fires over \$15 million in costs
Strategic			
<ul style="list-style-type: none"> Methodology 	Forest/district self-assessment, subsequent regional review using set criteria; issuance of national report	Combined CPR Team and regional review using set criteria, issuance of regional and national “roll-up” reports	National independent panel review, issuance of national report
<ul style="list-style-type: none"> Coverage Examples 	Jurisdictional authority FMP and LMP coverage and currency Use of scenarios to anticipate short and long-term fires and complexity given drought and fire severity indices and the reduction of natural barriers Risk management, values at risk identification (WUI considerations) Community wildfire protection plans	FMP utilization LMP utilization Resource availability and constraints Cost containment actions Indirect suppression activities Utilization of	Examination of regional reports Site visits to further examine strategic concerns, identify and assess “successful fire” metrics and possible better practices for national application
Operational			
<ul style="list-style-type: none"> Methodology 	National forest review using set criteria; report to region	CPR Team review using set criteria, findings provided to the host unit immediately	National independent panel review, issuance of national report
<ul style="list-style-type: none"> Coverage Examples 	Memorandums of understanding	AMR and suppression alternatives	Examination of CPR team reports

Decision Focus	Pre-Fire (Preparedness)	Fire Event (Response)	Post-Fire (Better Practices)
	Cost sharing and cost apportionment agreements Local contracts Tool expertise: WFSA, FSPRO, RAVAR Resource and business planning and guidelines	Tool utilization: WFSA, FSPRO, RAVAR, SCI Delegation of authority Resource availability and constraints Cost containment actions National team rotations and capability to meet fire's specific needs Documentation	Site visits to further examine operational concerns, identify and assess possible better practices

In addition, the model calls for the hierarchy of oversight fully embracing the requirements of a performance audit, such as that explained in the May 2007 Region Large Fire Cost Review Guidebook. Most importantly, the personnel performing the individual reviews must have sufficient expertise to plan and conduct the oversight review, provide assurance that review evidence is sufficient and appropriate to support findings and conclusions, and that developing a finding must include the elements of criteria, condition, effect, and cause. These all appear to be shortfalls in the current CPR and regional reviews to the extent they profess to be performance audits.

The Panel also encourages the Forest Service to consider the opportunity that its strategic plan offers for these reviews. Large fire costs are directly related to specific conditions that the USDA Forest Service Strategic Plan FY 2007-2012 recognizes. Any reviews should specifically address related Strategic Plan objectives, performance measures, and related means and strategies. In addition, the reviews could identify areas for improvement in the objectives, measures, and means and strategies.⁹ The Panel has identified several objectives and related performance measures that should be part of the core of reviews considering pre-fire mitigation and preparedness, individual fire management, and Forest Service basic management capabilities. These include:

Pre-Fire Mitigation and Preparedness

- Reduce the risk to communities and natural resources from wildfire (measures 1) number and percentage of acres treated to restore fire-adapted ecosystems that are a) moved toward desired conditions and b) maintained in desired conditions; 2) number of acres brought into stewardship contracts)
- Build community capacity to suppress and reduce losses from wildfires (percentage of acres treated in the wildland-urban interface that have been identified in community wildfire protection plans or equivalent plans)

Individual Fire Management

⁹ The Panel did not specifically review the appropriateness of the goals, objectives, measures, and means and strategies in the 2007-2012 Strategic Plan. However, some objectives are not fully covered by the Plan's performance measures or the measures do not match the objective. Attention should be paid to strengthening the measures.

- Suppress wildfires efficiently (percentage of fires not contained in initial attack that exceed a stratified cost index)

Forest Service Basic Management Capabilities

- Improve accountability through effective strategic and land-management planning and efficient use of data and technology in resource management (percentage of selected data in information systems that is current to standard)

The Strategic Plan also includes a schedule of future program evaluations. The Forest Service should consider adding large fire management and cost reviews to the list of program evaluations in its Plan.