Large Fire Cost Review for FY2009

Submitted by:
Secretary of Agriculture's Independent
Large Cost Fire Review Panel

Guidance Group, Inc.
Strategic Services for Fire Organizations

Large Fire Cost Review for FY2009

Submitted to:
Secretary of Agriculture

Submitted by:
Secretary of Agriculture's
Independent Large Cost Fire Review Panel

and

Guidance Group, Inc.
201 Baumgartner Place, NE
Eatonville, WA 98328
(360) 832-1447

August 2010

Table of Contents

EXECUTIVE SUMMARY

As requested by Congress, an independent panel reviewed the six 2009 wildland fires whose suppression costs exceeded $10 million (M). The six fires were: Backbone ($16.9M), Big Meadow ($16.9M), Knight ($12.1M), La Brea ($34.9M), Station ($94.7M), and Williams Creek ($14.2M). The Williams Creek fire occurred in Oregon, the others in California.

The primary purpose of the review was to determine whether agency personnel made prudent and cost effective incident management decisions in light of risk management considerations. In every case, agency administrators, their staffs, and incident personnel paid attention to balancing safety, cost, and risk management. As one would expect, the personnel involved in these fires learned lessons which, if applied, would improve performance in the future.

The U.S. Forest Service (Forest Service), as lead agency for the review, also tasked the Panel to review the use of new technology, tools and guidance on these fires, and to evaluate the large fire cost review process itself, making recommendations for improving its value.

To gather information firsthand, the Panel met at Forest Supervisors' Offices to interview agency administrators, incident commanders (IC), and other senior officials involved in decision making on the fires. National Park Service (NPS) fire officials from Yosemite National Park met the Panel at the Stanislaus National Forest Supervisor's Office. The Panel also analyzed cost data and reviewed documentation on the fires.

Key Findings

Prudent Decisions – The Panel found that overall, agency administrators and incident personnel made prudent decisions on each of these six fires in light of the risks and circumstances they faced, and that agency personnel paid considerable attention to risk management and cost containment.

All things considered, the Forest Service and NPS should take pride in how well their personnel performed under pressure in handling the complex situations they faced on the six large wildland fires we reviewed. The responsible units and incident management teams (IMT) could have reduced some costs on most if not all of the fires. However, without prudent decisions and consideration for costs and safety, the fire costs would, in all likelihood, have been much higher and property losses greater.

Cost Management – Agency administrators, their key staff, and ICs all proved very conscious of costs, and took steps whenever possible to limit costs. Built-in checks and balances largely worked. For example, agency administrators and their representatives examined the decisions of ICs, Geographic Area Coordinating Centers (GACC) reviewed resource orders, and cost unit leaders and incident business advisors (IBA) tracked and reviewed spending.

Costs of tactical operations were largely attributable to crews, engines, and aircraft. Indirect costs, which include (a) overhead and support personnel, (b) supplies, (c) catering, and (d) travel costs were largely proportional to the number of personnel fighting a given fire. Although the mix of direct costs differed among the fires, the proportion of indirect costs to direct costs proved very similar for all six fires. This consistency suggests the support system operated similarly across fires and as planned.

Savings vs. Costs – The agency administrators, their staffs, IMTs, state and local cooperators, and the thousands of firefighters involved in the firefighting, together saved tens of thousands of acres of wildland resources, a large number of homes, valuable commercial timber, watersheds, and significant amounts of infrastructure such as communications antennas and power transmission lines. The Panel believes that a lack of adequate metrics for comparing values saved to fire suppression costs represents one problem associated with past cost review efforts. We recommend an approach to measuring values saved, enabling Federal fire agencies to better evaluate the cost-effectiveness of wildland fire suppression.

Control of Cost Factors – The Panel found that many factors affecting fire suppression costs exist largely outside the control of the people managing large wildland fires. We discuss important cost factors in the next set of items, below. Some influences that take cost control out of the hands of agency personnel prove particularly acute in California.

Wildland Environment – As is well known, wildland fire suppression is increasingly complex because fires are more frequent, larger, and more intense as a result of climate change, drought, declining forest health, and accumulated wildland fuels. Trends also clearly indicate that the cost of wildland firefighting will continue to rise, with some annual variation. However, the majority of fire suppression costs appear justified within that context of growing complexity.

Initial Attack – Although we recognize that controversy exists regarding initial response to both the Station and Big Meadow fires, we generally found the initial attack on all the fires reviewed to be appropriate to the situation. Humans started some of the large cost fires, while lightning caused others. Each fire started on steep slopes, and several burned in designated wilderness. All of the fires originated at locations that firefighters found difficult to access. The Big Meadow fire resulted from an escaped prescribed fire in Yosemite National Park. Each high cost fire escaped despite rapid discovery and what local fire managers considered adequate resources for initial attack. In no case could initial attack resources stop the fire, typically because the fires were in difficult terrain, largely inaccessible, and because the fuel and weather conditions promoted rapid fire spread and extreme fire behavior. In almost every case, personnel recognized that these fires would become very large on the first day or two after they escaped initial attack. In two situations this conclusion was reached within hours of assessing the fire (Knight and Williams Creek).

Wildland-Urban Interface/ Intermix and Built Infrastructure – People continue to build homes and other structures in fire-prone environments. Protecting communities and community infrastructure significantly increased fire suppression costs on five of the six wildfires reviewed. The need to protect homes, non-residential structures in the wildland-urban interface (WUI), and other high value built infrastructure, limited flexibility in decision-making on some incidents, and led agency and incident personnel to adopt higher cost strategy alternatives and tactics. In some cases, even small numbers of homes threatened by the fire significantly affected fire suppression strategies, tactics, and costs.

Hazard Mitigation at the Landscape Level – On three of the fires (Big Meadow, La Brea, and Station) pre-fire fuel treatments played a significant role in the development of tactics, and reduced fire suppression costs. However, in several cases, fire officials stated that the lack of fuel treatments greatly increased the costs of protecting high value infrastructure (e.g., communication sites on Mt. Wilson during the Station fire).

Constraints on Vegetation Management – Agency efforts to modify fuels in an attempt to slow or stop an advancing wildfire were often limited by either policy, law, or outside influences over which the agency has little control. For example, on the Angeles National Forest, prescribed burning projects are limited to less than 100 acres because of air quality regulations.

High Value Natural and Cultural Resources – These fires also threatened high value natural and cultural resources, including watersheds important for urban needs, critical wildlife habitat, designated threatened and endangered species habitat, commercial timberlands, anadromous fish streams, and sites of cultural and historic importance to Native American tribes. As one would expect, consideration for these resources clearly affected strategic choices and tactical decisions, often resulting in higher fire suppression costs.

Land/Resource Management Plans and Fire Management Plans – Management direction in land/resource management plans (LRMP) and fire management plans (FMP) in the areas of the six fires rarely incorporated specific risk or cost management considerations. This shortcoming affected wildfire suppression costs in that they did not adequately inform, from a cost standpoint, decisions that drove the fire suppression strategy. As a result, assumptions in these plans may have inadvertently driven suppression costs higher.

Incident Management Teams – A variety of IMTs, in a variety of combinations, managed the six fires reviewed; sometimes in uncommon combinations and sometimes making an expedited transition to local Type 3 IMTs. On some fires, more than one level of team worked together on the incident at the same time (e.g. a National Incident Management Organization [NIMO] team and an IMT-1) with mixed results.

Agency Administrators' Role – Agency administrator (line officer) engagement in fire management seems to be increasing in both in quantity and quality. In all cases we reviewed, the agency administrators engaged fully in the decision-making. Overall, agency administrator involvement appeared beneficial in containing costs and assuring sensible risk management. Positive, effective working relationships between agency administrator and IMTs proved critical to success on several of the fires. When this relationship was less than effective (as was the case on one fire), or lines of authority are confused (as was the case on another), decision-making slowed down with direct implications for efficiency and cost. Ironically, on some fires, agency administrators and their representatives may have been too involved, with multiple senior people on the scene, giving conflicting direction to the IMT. Lack of clear intent, tentative decision-making, and failures to nurture effective relationships with ICs and their teams, on the part of agency administrators and their staff, can have both direct and indirect cost implications, including the overuse of costly resources such as airtankers and heavy helicopters. In some cases, agency administrators might have been more effective in insulating IMTs from political and social pressure to use expensive, unwanted resources.

National Incident Management Organization Teams – Agency administrators used NIMO teams on three of the six fires we reviewed, each in a different way. Results were mixed—one effective; one problematic; and one effective, but not without causing concern. The Panel believes that NIMO teams have the potential to help reduce incident costs by bringing significant decision support skills and experience as well as the ability to mentor other IMT and unit personnel but the Forest Service needs to clarify their role.

Incident Business Advisors – On each fire where incident business advisors (IBA) were available, the agency administrators and ICs considered the IBA an asset in controlling costs. They helped track expenditures, identified potential costs, and provided advice on cost saving alternatives as well as agency policy. While it proved difficult for the Panel to determine whether the IBAs saved money, agency and incident personnel want them assigned to their fires, and they proved to be in shorter supply than desired.

Delegations of Authority – Judging from the fires we reviewed, letters delegating authority to IMTs rarely contain specific cost containment direction. We believe that the agencies need to provide more specific guidance for containing costs on each fire.

Direct Protection Area Boundaries – Direct protection area (DPA) boundaries often fall along land ownership and political boundaries, rather than along defensible topographic features. Therefore, agencies often find themselves faced with trying to stop wildfires at very difficult locations, such as at mid-slope, as was the case on the La Brea fire. To address this situation, the Forest Service and their partners have relocated some DPA boundaries to defensible locations, requiring the Forest Service to protect state or private lands adjacent to National Forests in order to create a sensible DPA. In California, this means that the Forest Service DPA may include lands formerly designated as either state responsibility area or local responsibility area. Such an arrangement, while making sense politically, or even operationally, can add significantly to Forest Service fire suppression costs by making the agency responsible for protecting structures and associated infrastructure.

Firefighter Safety – The wildland fire agencies have engendered a remarkable culture change over the past 15 years, by putting greater emphasis on firefighter safety. What the agencies have not made clear to the Congress is that in that time, addressing firefighter safety concerns has also, necessarily, increased the costs of providing fire suppression. Firefighter safety mitigations on individual fires also bear costs, and firefighter safety concerns affected strategy and likely affected fire costs on every fire reviewed. Most of the six fires we studied started in locations and under conditions in which direct attack would have been extremely dangerous. Fire locations and conditions necessitated indirect attack, enlarged fire perimeters, and increased the length of firelines, all of which increased the amount of labor required and resulting costs.

Costs of State and Local Fire Agency Resources – In California especially, interagency IMTs increasingly depend on state and local agency personnel for staffing. Up to 60% of the personnel on interagency IMTs in California come from state and local government agencies, which increases the cost of IMTs because state and local fire personnel in California often receive higher salaries as well as more costly benefit and overtime provisions. Many are paid portal-to-portal (24 hours per day) while on fire assignments, as required by agreements between their unions and their employers. Arrangements such as added administrative fees and minimum commitment periods also increase the costs of these personnel. Local and state engines and other staffing also cost more than comparable Federal agency resources for reasons similar to those mentioned for IMT personnel. The same is true for some handcrews.

National Mobile Food Services Contract – Although the concept of negotiating national contracts for certain key suppression resources and support services is sensible and cost-effective from a national standpoint, it can restrict local flexibility in contracting for certain support services, such as food service. Local fire officials and IMT personnel on several fires in California stated that they could have saved money by providing meals to firefighters using less expensive CAL FIRE mobile kitchen units when they transitioned to a Type 3 organization. Unfortunately, the Panel did not have the opportunity to verify the potential savings referenced.

Mop Up Operations/Maintaining Fire Control – On every fire reviewed, the ICs seemed conscious of the costs of retaining large numbers of resources on-site after their fire reached containment. All seemed to try to demobilize as fast as they thought was safe and prudent. However, in the process of ramping down, ICs frequently hold some resources. On paper, this might seem like demobilization was slower than desirable. However, the IMT must finish mopping-up remaining fire and maintain a reserve force to respond to weather changes, unanticipated fire behavior, and other contingencies. In some cases, the GACC may elect to stage resources at an existing fire as a base from which to attack emerging fires, rather than duplicating mobilization costs and mobilization time.

Aviation Operations – On all six fires the Panel reviewed, ICs employed large scale aerial attack early, usually intending to slow the fire's growth or protect structures with retardant or water. IMTs employed retardant variously in conjunction with ground forces, while ground forces were being assembled, and in areas where they believed direct ground attack was not safe. IMTs also made extensive use of helicopters, including Type 1, or heavy helicopters to drop water or retardant to support fireline construction by ground crews. Costs of aviation resources accounted for 14%–29% of total fire costs, and represent a significant cost center. The Panel questioned the effectiveness of some aerially delivered retardant on four of the six fires reviewed. Ironically, a perceived lack of retardant use early in the fire lies at the heart of controversy concerning the extended attack on the Station fire.

Very Large Airtankers – Jet powered very large airtankers (VLAT) represent a developing wildland firefighting tool, which the IMT used in 2009 on the Station fire. These aircraft included two DC-10s and a Boeing 747, both specially configured for dropping fire retardant. These VLAT carry a much larger payload than conventional airtankers, but are not as maneuverable over steep terrain. They are much more expensive than conventional airtankers, and their functionality, effectiveness, and efficiency remain to be proven, though incident management personnel thought the DC-10s were cost-effective on the Station fire.

Political and Social Pressures for Retardant Use – Airtankers and heavy helicopters have become the most visible images of wildland fire suppression operations over the past 20 years. Images of airtankers and helicopters dropping water and retardant appear on the front page of newspapers, on the nightly TV news, and on Internet video sites. Many in the public, the media, and the political arena now believe that airtankers and heavy helicopters are the most critical tool for suppressing wildfires. When fire managers do not use these resources, people believe that firefighting agencies are failing to use all available resources to save structures and natural resources. Because of the publicity surrounding the new VLAT, there is even greater pressure to use them, even when their effectiveness may be limited.

Wildland fire agencies know that while airtankers and heavy helicopters can be effective tools, they can also prove inappropriate, particularly since they represent expensive tactical tools, and because flying firefighting aircraft expose air crews to risk.

Cost Sharing – The participating agencies established effective cost share agreements for the Knight, La Brea, Station, and Williams Creek fires, in accordance with the appropriate master agreements. A cost share agreement was not necessary on the Backbone fire as it burned entirely on national forest lands. The Big Meadow fire was an escaped prescribed fire which, by policy and agreement, required the NPS to pay the full suppression costs. In each case, the responsible parties appear to have adequately tried to assure that the cooperating agencies shared fire costs commensurate with their jurisdiction and responsibilities. Given the diligence apparent in these documents, the Panel believes that neither the Forest Service nor the NPS paid significant costs that they should not have.

Tools and Technology – Incident management teams, agency administrators, and their staffs are making greater use of decision support tools, including computer modeling, than ever before. Incident management teams also used airborne infrared equipment, and made use of computer technology in the field. Generally the decision-makers on the six fires reviewed gave the new tools good marks, and said they helped in decision-making, and in documenting and communicating risk management and cost management decisions. However, additional training, support and experience with the new tools appear necessary.

Cost Review Process – While the large fire cost review process has been of value, it includes redundant efforts whose findings reach too few of the people who make important decisions affecting fire costs.

Recommendations

The Panel focused on recommendations that can significantly affect large fire costs and risk management. Previous review panels have proposed recommendations very similar to some of ours, but the recommendations have gone unfulfilled. We also offer recommendations on the use of new technology, metrics of cost-effectiveness, and the review process itself.

1. Mitigation for the Wildland-Urban Interface and Built Infrastructure

Recommendation: Create more effective alliances and relationships with WUI communities to reduce the exposure of homes, businesses, and associated built infrastructure (e.g., power lines, communication, and other high value resources).

These relationships and alliances include those with state and local government, builders and developers, home and business owners, and the insurance industry. The goal should be to achieve "fire adapted communities" through a combination of public education, creation of defensible space, building and subdivision codes and ordinances, and land use planning in fire prone areas.

2. Agency Administrator Role and Direction

Recommendation: Ensure a clear line of authority and communication between agency administrators and the IMTs, especially when multiple agencies or agency units are involved. If NIMO teams are used make sure they have a clear role coordinated with the role of other assigned IMTs. Make sure that delegations of authority and letters of intent provide clear direction, including specific cost related guidance such as limiting airtanker use or very expensive resources, as appropriate

The agency administrator must establish clear intent, remain visible and make plenty of time available for direct interaction with the IC/IMT. A key role for the agency administrator may be to insulate the IMT from political and social pressure to use expensive resources where they may not be warranted.

3. Incident Business Advisors

Recommendation: Conduct an IBA needs analysis, develop an IBA recruitment strategy, and then recruit and train more IBAs, especially in areas where larger fires are common.

Incident business advisors are required by Interagency Standards for Fire and Aviation Operations. All things considered, they represented a useful asset but are in critically short supply.

4. Direct Protection Area Boundaries

Recommendation: Where necessary, realign DPA boundaries to assure they better coincide with defensible topographic features rather than political or ownership boundaries.

Realigning DPA boundaries may, in some cases, necessitate having state or local government agencies protect some Federal lands.

5. Hazard Mitigation at the Landscape Level

Recommendation: Focus fuel reduction efforts both on Federal and non-Federal lands in the areas with high value resources at risk, such as the WUI, with an emphasis on creating community defensible space and fuel hazard reduction zones. Properly space, sequence, and maintain fuel treatments to meet these aims.

This is consistent with the 2009 Quadrennial Fire Review.

6. Land/Resource Management Plans and Fire Management Plans

Recommendation: When revising LRMPs and FMPs, Federal agencies should include an analysis of potential suppression actions and recognize the suppression constraints and fire behavior conditions that their planning decisions create which may impact fire costs.

This subject is thoroughly discussed in “Large Fire Suppression Costs – Strategies for Cost Management, 2004”.

7. Public Education on Air Operations

Recommendation: Plan and implement a multi-pronged educational effort directed to the public, media, and political interests, showing the appropriate uses and limitations of airtankers and heavy helicopters.

The agencies need to help the public, media and politicians to understand when fire agencies can succeed with aviation assets, particularly aerially delivered retardant, and when they cannot; and help those audiences adjust their expectations relative to the use of aviation assets. The agencies could also further empower both agency administrators and ICs to say "no" to pressure to inappropriately use retardant or heavy helicopters.

8. Agreements

Recommendation: Evaluate the cost provisions of existing cooperative agreements with state and local cooperators in California and renegotiate where necessary.

Examine whether Federal agencies should be obligated to pay plans negotiated between cooperators and their employees, such as portal-to-portal payment and overtime rules; as well as high overhead rates, administrative fees, minimum commitment requirements, and other factors in an effort to reduce the cost of these agreements. Payment to cooperators should be limited to those that reimburse the cooperator for added incremental costs incurred by the cooperator as a result of participating in the fire.

9. National Mobile Food Services Contract

Recommendation: Allow more flexibility in the application of the National Mobile Food Services Contract to allow for locally acquired food service alternatives when savings can be demonstrated.

National contracts, particularly for catering, can drive costs up in some circumstances, particularly on fires with low to moderate staffing. The Federal agencies should renegotiate the contracts with national caterers to raise the threshold at which the Federal wildland fire agencies are obligated to order services from the National Mobile Food Service Unit (MFSU) contractors. Allow local units the flexibility to use an alternative to a nationally contracted MFSU. For example, the government could elect to use a local alternative when the number of meals being served on the incident remain below, or fall below, 900 and incident personnel could demonstrate a savings by using a food service alternative.

10. Improve Utility of Key Decision Support Tools

Recommendation: Make three improvements in the use of decision support tools.

1. Provide more and better training on Wildfire Decision Support System (WFDSS), FSPro, and RAVAR to agency administrators, their staffs and IMT members; focus on developing local capability that agency units can activate in the very early stages of a fire.
2. Revise WFDSS to incorporate the Key Decision Log (KDL) and long term assessment.
3. Revise RAVAR to better account for a broader range of values, such as commercial timberland.

Agency personnel will find these tools more valuable if they receive comprehensive training and as they gain experience in using them.

11. Infrared-Equipped Air Attack Platforms

Recommendation: Encourage use of Infrared (IR)-equipped air attack platforms.

While their initial costs appear to be higher, their use can result in significant cost savings that justify the relatively higher initial expense.

12. Supply Accountability

Recommendation: Use barcode and smartcard technologies to track and account for non-expendable supplies to the extent possible.

Supply costs represent one of the larger indirect costs. On some fires the loss/use ratio for supplies exceeded the target ratio of 15%. One fire employed a bar coding system that tied issued supplies and equipment to individual personnel via a card system, to improve the ability to track and account for supplies and equipment; they experienced a low loss/use ratio.

13. New Metrics

Recommendation: Use a measure of worker injuries, similar to that used by OSHA, to assess safety at fires.

Recommendation: Develop a metric for estimating values conserved, and comparing them to fire costs, as a way to reflect the true cost-benefit of wildland fire suppression.

The latter metric will explicitly show what the citizens got for their money. Agencies already report the cost of the fire, acres burned, and houses destroyed but not the property, environmental values, and lives saved. Data from RAVAR on the risks protected and data from FSPro on the likely extent of the fire can be used to estimate what was saved. For example, the Station fire cost $95M, but conserved more than $1B in property, which puts this fire in a very different light.

14. Cost Review Process

Recommendation: Revise the cost review process to replace the current Large Fire Cost Review process with one less oriented to oversight and more oriented to organizational learning; ensuring implementation of recommendations; creating a single, comprehensive suite of reviews; and providing a more effective performance period for the contractor and panel.

A fuller discussion of each finding and recommendation appears in Chapter IV.

This page intentionally left blank.

ACKNOWLEDGEMENTS

We greatly appreciate all the professionals in the U.S. Forest Service and the National Park Service who assisted this review in many ways. Below are the names of those we interviewed in-person or by conference call or who otherwise contributed to the review. We appreciated their candor and professionalism.

We also appreciate all of the individuals at Forest Supervisors' Offices who were instrumental in making us feel welcome. Positions below were those at the time of the review.

U.S. Forest Service – Washington Office

Ronald Bertsch	Acting Assistant Director of Fire and Aviation Management for Planning and Budget
Jaelith Hall-Rivera	Acting Assistant Director, Planning and Budget, Fire and Aviation Management (and Project Manager for this review)
Erica Kim	Fire Operations Specialist
Richard Kvale	Deputy Director, Fire & Aviation Management
Matthew Olson	Contracting Officer, NIFC
Beattra Wilson	Urban Forestry Program Specialist

National Park Service – Washington Office

William Kaage	Branch Chief, Wildland Fire

U.S. Forest Service, Pacific Southwest Region – Regional Office

Dorothy Albright	Resource Information Specialist
Ralph Domanski	Assistant Director, Fire and Aviation Management
Sheri Elliot	Incident Business Program Specialist
Joe Millar	Assistant Director, Fire and Aviation Management
James Pena	Deputy Regional Forester

U.S. Forest Service, Pacific Northwest Region – Regional Office

Cici Chitwood	Incident Administration Coordinator
Carla Schamber	Program Specialist

National Park Service, Pacific West Region

Sid Beckman	Deputy Regional Fire Management Officer

Backbone Fire (Six Rivers National Forest)

Mike Beasley	Division Chief/District Fire Management Officer, Lower Trinity Ranger District, Six Rivers NF
George Custer	Incident Commander, Atlanta NIMO
Nancy Gibson	Deputy Forest Supervisor, Six Rivers NF
Patricia Grantham	Forest Supervisor, Klamath NF
Edward Guzman	Forest Fire Chief, Klamath NF
Thomas Hudson	District Ranger, Mad River Ranger District, Six Rivers NF
Tyrone Kelley	Forest Supervisor, Six Rivers NF
Michael Minton	Deputy Forest Fire Management Officer, Six Rivers NF
Matthew Nelson	Forest Safety Officer, Six Rivers NF
William Rice	District Ranger, Lower Trinity Ranger District, Six Rivers NF
Kent Swartzlander	Forest Fire Chief; Incident Commander, NCIMT-1

Big Meadow Fire (Yosemite National Park)

Charles Cuvelier	Chief Ranger
Kelly Martin	Park Fire Chief
Deron Mills	Park Deputy Fire Chief
Dave Uberuaga	Acting Superintendent
Jerry McGowan	Incident Commander, CIMT-1

Knight Fire (Stanislaus National Forest)

David Cooper	Deputy Incident Commander, South Central Sierra IMT
Ann Denton	District Ranger, Mi-Wok Ranger District, Stanislaus NF
Marty Gmelin	Resource Management, Mi-Wok Ranger District, Stanislaus NF
Jerry McGowan	Forest Fire Management Officer
Susan Skalski	Forest Supervisor, Stanislaus NF
Christina Welch	Deputy Forest Supervisor, Stanislaus NF

La Brea Fire (Los Padres National Forest)

Anthony Escobar	Forest Fire Management Officer, Los Padres NF
Kenneth Heffner	Deputy Forest Supervisor, Los Padres NF
Peggy Hernandez	Forest Supervisor, Los Padres NF
Jeanne Pincha-Tulley	Incident Commander, CIMT-3

Station Fire (Angeles National Forest)

David Conklin	Forest Fire Management Officer, Angeles NF
Michael Dietrich	Incident Commander, CIMT-5
Martin Dumpis	Deputy Forest Supervisor, Angeles NF
James Giachino	Deputy Incident Commander, CIMT-5
Carlton Joseph	Incident Commander Trainee, CIMT-5
Angela Lavell	Management Analyst, Angeles National Forest

Williams Creek Fire (Umpqua National Forest)

Carol Cushing	District Ranger, North Umpqua Ranger District, Umpqua NF
Clifford Dils	Forest Supervisor, Umpqua NF
Josey Elefritz	Budget Officer, Umpqua NF
Brett Fillis	Deputy Incident Commander, ORCA IMT
Joseph Linn	Fire and Natural Resources Staff Officer, Umpqua NF
Dennis Sifford	Incident Commander, ODF IMT 2
Sheryl Tooker-Dilley	Deputy Fire Staff Officer, Umpqua NF
Adam Veale	Assistant Fire Management Officer, North Umpqua Ranger District, Umpqua NF

Project Staff

Michael DeGrosky	Project Manager
Philip Schaenman	Deputy Project Manager
Maria Argabright	Project Assistant
Bill O'Brien	Analyst

Independent Panel

Donald Artley	Panelist
Richard Mangan	Panelist
Peter Moy	Panelist
Philip Schaenman	Panelist
Paul Woodard	Panelist

Short biographies of the Project Manager and Panel members are given in Appendix A.

This page intentionally left blank.

CHAPTER I. INTRODUCTION

As mandated by Congress, an independent panel reviewed the six wildland fires occurring in 2009 that cost over $10M to suppress. Congress established the requirement for such reviews in 2005, and has renewed the mandate each year since.

The six fires that met the review criteria are listed below. Their approximate locations, one in Oregon and the rest in California, are shown in Table 1.

Table 1: Large Loss Fires Reviewed

Fire Name	Cost	Acreage	Duration
Backbone	$16,897,750	6,324	20 days
Big Meadow	$16,947,244	7,418	25 days
Knight	$12,122,452	6,130	25 days
La Brea	$34,888,910	89,489	44 days
Station	$94,739,316	160,577	41 days
Williams Creek	$14,226,245	8,400	20 days

Figure 1: Location of Large Loss Fires in 2009

The Forest Service awarded a competitive contract to Guidance Group, Inc. of Eatonville, Washington to form the Panel and manage its work. The Guidance Group assembled a five-person panel of experts with diverse backgrounds in wildland fire management, organizational leadership, finance, natural resource policy, and performance metrics.

The report is primarily intended for the Secretary of Agriculture, Secretary of the Interior, and Congress. However, the authors have also endeavored to produce a report that will prove useful for the people making the policy, strategic, and operational decisions that drive fire costs. In the course of our review, we reinforced many lessons previously learned, but also found some potentially important new ideas.

Scope of Work

The Forest Service gave the independent Panel and Guidance Group the following tasks:

- Evaluate the risk-based management of these large fires from a systems standpoint—from planning and decision-making through implementation and the outcomes that resulted. For each of these stages, people, skills, and technology were to be assessed and what in the system worked well and what in the system needs to be improved were identified.
- Assess the utilization of new processes, guidance, expectations, and tools that have changed the business of fire management in recent years in an effort to determine the impact these changes have had and develop a baseline for comparison in future years as these efforts mature.
- Determine whether the agency's current review process is yielding positive changes and identifying ways to improve the agency's current fire review processes.

Methodology

Kickoff Meeting/Call – The study started with a kickoff meeting and conference call at the U.S. Forest Service Headquarters in Washington, DC, under the coordination of Jaelith Hall-Rivera, the Forest Service's Project Manager. Representatives of both Forest Service regions qualifying fires in 2009 participated by conference call, along with representatives of the National Interagency Fire Center. We received project guidance to not only meet the Congressional request to consider fiduciary prudence, but also to make the report useful to agency field units. The statement of work also asked that we consider ways to improve the review process for large fires.

Data Collection – The Forest Service and NPS provided various reports and other sources of data pertaining to each fire to be reviewed; the last three previous large fire cost review reports; and other documents relating to both the costs of large fires and the conduct of internal reviews. The Panel continued to obtain additional data throughout the project.

Conference Call with Deputy Regional Forester – Since five of the six fires were in Forest Service's Pacific Southwest Region (Region 5), the Panel sought the view of the Deputy Regional Forester with responsibility for fire as to what drove the fire costs both overall and on particular fires.

Field Interviews – Because the Panel had only six fires to review, versus more than 20 in each of the two preceding years, we were able to visit each responsible office and interview people in-depth about each fire and the decisions that affected costs. With the exception of the Big Meadow fire, the Panel conducted its interviews at the office that had prime responsibility for the fire. For the Big Meadow fire, NPS personnel met the Panel at the Stanislaus National Forest Supervisor's office.

Interviews on-site included agency administrators, their deputies, ICs and their deputies, agency fire chiefs or fire management officers, and other senior staff. In some cases, individuals who could not participate in-person, either contributed to discussions by conference call, or the Panel interviewed them separately. For every fire the Panel was able to interview people representing both the perspectives of agency management as well as the IMT.

When fires involved more than one National Forest or agency unit, or a Federal agency joined a non-Federal agency in unified command, each had opportunity for representatives to participate in person or by conference call.

At each field meeting in the Forest Service's Pacific Southwest Region (Region 5), the Region's Incident Business Program Specialist participated, as did a Regional Data/GIS Specialist to help answer questions, provide ancillary data and logistical support, and to integrate the Panel's efforts into the region's review effort. In the Forest Service's Pacific Northwest Region (Region 6), the Regional Incident Administration Coordinator helped organize the site visit and was represented by a Program Specialist.

The Panel found the interviewees quite candid, and the senior fire and agency personnel shared as much time as was needed to discuss the fires. The Panel had much ground to cover, an ambitious timeframe, and a fixed budget, but felt we had ample time with the interviewees.

All those interviewed had clear rationales for their decisions and the factors that most affected costs. Many offered suggestions for improvement. While Monday morning quarterbacking might cause one to question a decision to use a particular strategy or certain tactics, it was the Panel's unanimous opinion that the decision-making on each fire was thoughtful, and strived to make effective use of the available decision support tools, as discussed later in this report.

The Panel distributed a set of questions to the participants prior to each site visit or phone. The Panel varied the questions only slightly from interview to interview, and the questions shown in Appendix B describe the essential set. At each meeting, the Panel asked a senior fire official to start the discussion with a summary of the fire and the key decisions made. Panel members were free to ask their own questions to supplement the standard questions or to clarify what they had heard.

In each case, the Panel found that incident personnel had made prudent expenditure of funds, in the sense that they weighed competing risks, considered costs right from the outset and then continued to pay heed to costs throughout the fires. Agency personnel did not uniformly agree on all strategic decisions and courses of action, but all made thoughtful decisions and had reasonable rationale.

Conference Call with Pacific Southwest Region 5 Assistant Directors – After the on-site visits the Panel held a conference call with two Assistant Directors of Fire and Aviation for Forest Service Region 5, at their request. The subjects included factors affecting fire costs from the GACC perspective, competition for resources between fires, and factors affecting which resources the GACC fills orders with.

Panel Meetings – The Panel travelled together in vans, stayed at the same hotels, and dined together. This allowed a continuum of formal and informal meetings to discuss findings and prepare for the next meetings. In addition, the Panel and Guidance Group's Project Manager assembled in Seattle after the site visits were completed and drafted the interim report. We discussed the key findings and recommendations, and assignments for completing the both the interim and final reports.

Preparation of Interim Report – On July 23, 2010, the Guidance Group delivered an interim report to the Forest Service Project Manager on behalf of the Panel. Production of the interim report followed a consensus-based process, and each member affirmed their approval of the report prior to submission.

Preparation of Final Report – Production of the final report followed a similar consensus-based process that the Panel used to develop its interim report. Each member has affirmed their approval of this report prior to submission.

Cost Data – The Panel primarily based their analyses on costs contained in the I-Suite database. The Panel obtained additional cost information from the Forest Service financial system and other documents provided by both Forest Service and NPS staff during our site visits. I-Suite is an interagency application provided to manage and track information in the incident business management functions, and the data can consist of estimates or actual costs. These data are reasonably accurate estimates rather than final accounting figures, but typically are quite close to the actual. The Panel found some inconsistencies in the classification of incident costs for the six fires we reviewed, but overall, the Panel remains confident that I-Suite data provided a sufficient basis for the level of analysis required, and that our analysis reflects an adequate understanding of the costs of these fires, enabling us to reach meaningful conclusions.

Organization of Report

Following this introduction (Chapter I), Chapter II discusses each of the six fires. We give a brief description of the fire circumstances and actions taken, the major positive and negative factors that affected costs, and findings pertaining to that specific fire. We considered wide-ranging data on each of these fires including final narratives prepared by the IMTs, KDLs, ICS-209 Incident Status Summaries, WFDSS records, and concluded with a comparison of cost factors across the fires.

Chapter III provides an analysis of financial data across fires.

Chapter IV provides overall findings on major cost factors, and the Panel's recommendations for reducing costs. The Panel based some findings and recommendations on patterns experienced across all six fires, while basing others on important lessons learned from one or two fires. This chapter also answers the questions posed in the statement of work regarding the agencies' use of technology, decision support tools and guidance, as well as the cost review process itself.

Five appendices appear at the end of the report. Appendix A contains biographies of the project staff and Independent Panel. Appendix B shows a typical questionnaire used during site visits and other interviews. Appendix C contains a glossary of acronyms and terms used in this report. Appendix D lists much of the key literature the Panel reviewed and used. Appendix E shows the daily costs by category for each fire.

This page intentionally left blank.

CHAPTER II. FY2009 LARGE COST FIRES

This chapter provides an overview of each of the fires exceeding $10M in 2009, and a map showing the progression of the fire day by day. For each fire, we also present what the Panel thought constituted the most important factors that either increased or decreased costs, and the Panel's findings about cost control and related issues. The factors affecting costs are based on discussions with key incident management personnel, our financial analysis of costs (Chapter III), and documentation of the fire. Overall findings considering the group of 2009 fires as well as recommendations for reducing costs in the future are discussed in Chapter IV.

Backbone Fire

Fire Data

- **Fire Location**: Six Rivers National Forest, Humboldt County, CA
- **Dates**: July 1–23, 2009
- **Acres Burned**: 6,324 acres
- **Estimated Cost:** $16,897,750
- **Peak Personnel Assigned**: 1,195

Fire Overview – A lightning strike ignited the Backbone fire in a part of the Trinity Alps Wilderness on July 1, 2009 that had burned during the 1999 Megram fire. Personnel from the Six Rivers National Forest discovered and attacked the fire on July 2. Fire behavior was active, with a large number of spot fires igniting 1/8 mile ahead of the main body of the fire. The remote nature of the area and lack of road access made reaching the fire difficult, precluding the use of ground equipment, so initial attack forces used aerially delivered retardant to slow the fire's spread.

Active burning occurred on both July 4 and 5. After that, conditions moderated, allowing firefighters to engage more. The fire (originally designated LT-17) burned into another wildfire on the adjacent Shasta-Trinity National Forest, and was re-named the Backbone fire.

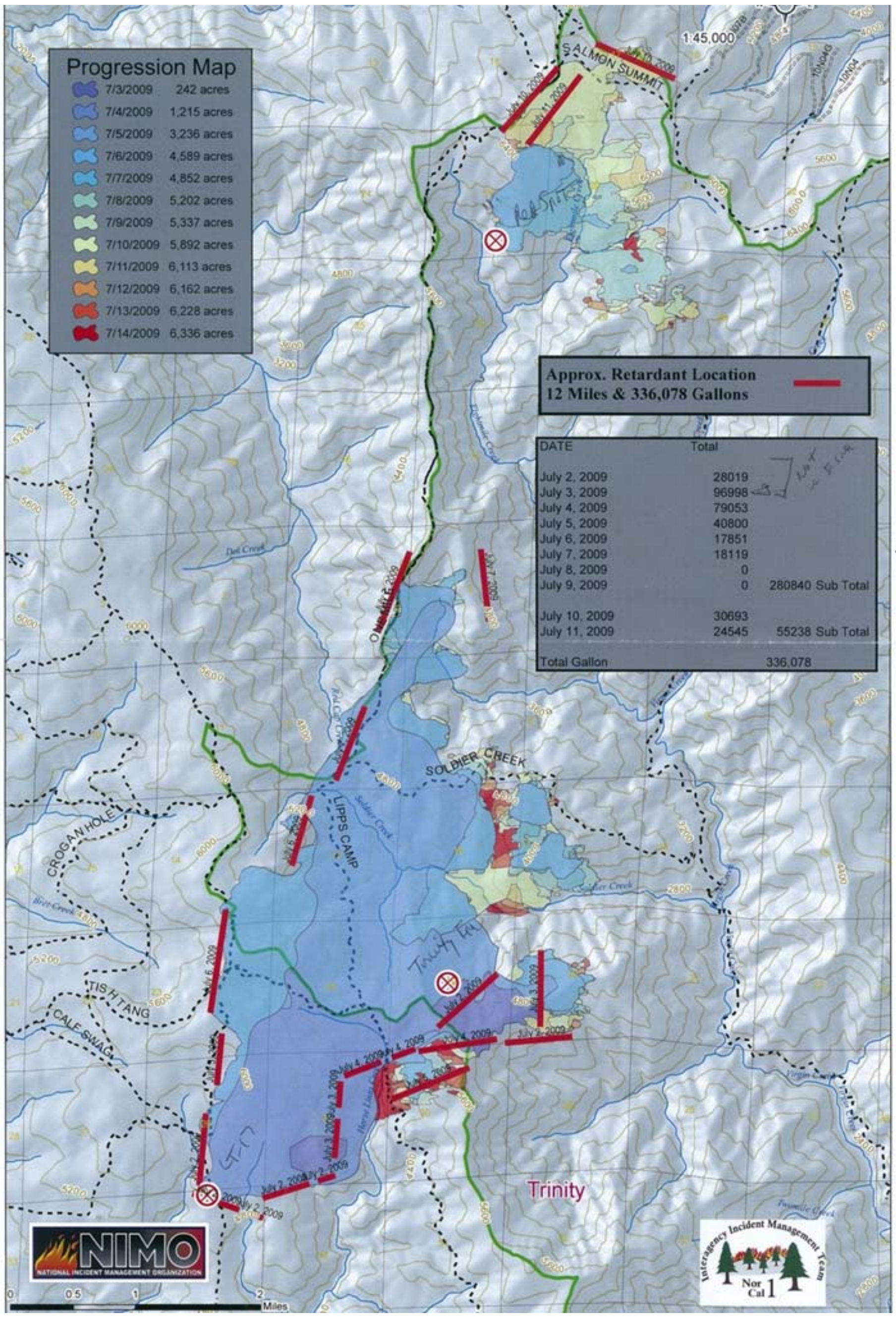
In its early stages, a local Type 3 IMT managed the fire. After re-evaluating the complexity of the incident, the Forest ordered and assigned both a NIMO team and a Type 2 IMT to the Backbone fire.

Nearby, a new fire emerged, named "the Red Spot" because fire personnel thought it may have been caused by spotting from the Backbone fire. The Forest Service and IMT included the Red Spot in the overall suppression planning and effort for the Backbone fire. At this time, the Deputy Regional Forester designated the Forest Supervisor of the Six Rivers National Forest as the lead agency administrator on this fire, which was impacting three national forests.

After having burned actively until July 6, weather conditions moderated, and fire spread diminished significantly. However, because the fire season had months to go, the Forest Service and IMTs continued efforts to fully contain, control, and finally mop up the fire, so that lingering hotspots would not remain an escape threat for several months and so that the Forest could avoid committing local resources to keep watch over this incident for the duration of the fire season. The NIMO team and Type 2 IMT demobilized from the fire on July 23, and a local Type 3 IMT finished work on the fire. Figure 2 shows the progression of the fire day-by-day, with the blue areas the early growth and the red the last day's growth.

During this fire, Apprentice Firefighter Thomas Marovich perished in an accident during routine rappel proficiency skill training at the Backbone Helibase in Willow Creek.

Figure 2: Backbone Fire Progression Map, July 2–18, 2009



Source: Six Rivers Forest

Major Cost Factors

Factors that increased costs:

1. *Terrain/Access* – Steep slopes, inaccessible nature of the area, and formal wilderness designation required the extensive use of Type 1 handcrews.
2. *Fuels* – Heavy fuels and standing snags from a previous fire caused intensive fire behavior, frequent spotting, and significant resistance to control.
3. *Private Timberland* – High value commercial timberland on the Hoopa Valley Indian Reservation (a sovereign nation) adjacent to the fire area increased pressure for aggressive suppression action.
4. *Aviation Support to Spike Camps* – Long travel distances and lack of road access to the fire area necessitated the establishment of spike camps, which require costly aviation resources to shuttle in support.
5. *Public Pressures* – Communities in the fire area endured several large, long-duration fires over the last decade. Public unhappiness with long-duration fires and their resulting smoke created pressures to rapidly extinguish the fire. This pressure precluded less active suppression strategies and tactics that would have resulted in a longer duration but potentially less costly effort.

Factors that decreased costs:

1. *Interforest Coordination* – Close coordination between the three national forests involved eliminated duplicated effort and the potential caused by multiple lines of communication between agency administrators and incident personnel.
2. *Reduced Air Operations* – Once large numbers of handcrews were on the fire line, the IMTs quickly reduced their use of aerially- delivered retardant below levels used in the earliest days of the fire.

Findings

1. *Initial and Extended Attack* – The initial attack and extended initial attack efforts were appropriate with the previously planned resources, although unsuccessful.
2. *Cooperation Between Federal Entities and Use of Incident Management Teams* – With the fire impacting three separate national forests, coordinated effort by those forests, the designation of a single agency administrator, and a single, clear, delegation of authority(DOA) to the assigned IMTs all led to clearer leader's intent and increased efficiencies on the fire.

   In addition, the coordinated use of a NIMO Team and a Type 2 IMT proved effective and efficient in implementing the unified direction of the agency administrators.
3. *Use of Handcrew and Aircraft Resources* – The IMT effectively combined handcrews and aircraft, primarily relying on aircraft to support firefighters on the ground and tactical situations where firefighters could follow-up water and retardant.

4. *External Influences* – The desire to minimize the fire's impact to adjacent private industrial forest land and to minimize the fire's duration to avoid a long-term smoke episode lasting weeks, if not months, dictated suppression strategies and tactics that increased costs.

Big Meadow Fire

Fire Data

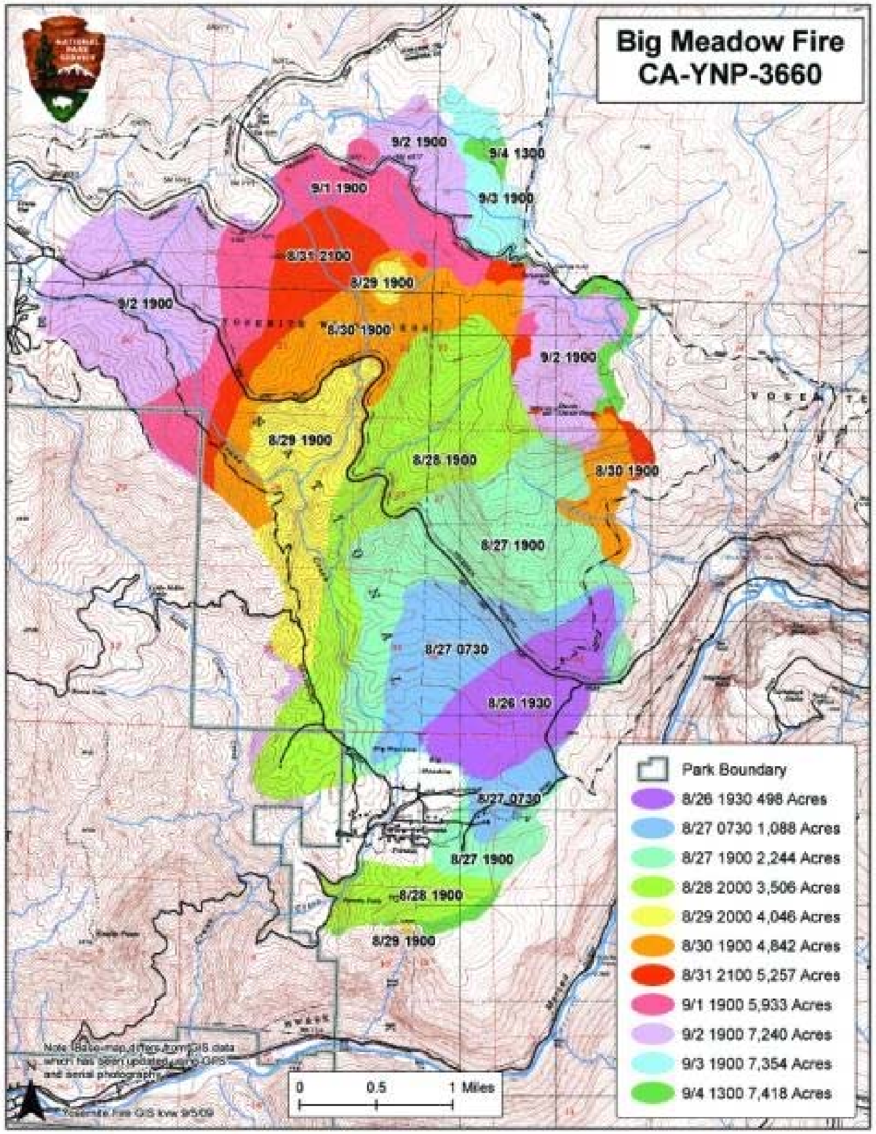
- **Fire Location:** Yosemite National Park, Mariposa County, CA
- **Dates Burned:** August 26–September 19, 2009
- **Acres Burned:** 7,418 acres
- **Estimated Cost:** $16,967,631
- **Peak Personnel Assigned:** 1,329

Fire Overview – The Big Meadow fire started as a prescribed fire that escaped in Yosemite National Park, adjacent to the community of Foresta, at about 1015 on August 26, 2009. The fire began spotting outside the containment line almost immediately upon ignition, and was declared a wildfire at 1210. The fuel conditions in the area, including standing snags remaining from a previous fire, increased resistance to control, and firefighters were unable to contain the spot fires. Fire danger remained at its seasonal average, but the burning index, a fire danger measure used to describe the potential amount of effort needed to contain a fire, had risen close to the 97th percentile and was trending up. The energy release component, a fire danger measure used as a measure of long-term drying and drought, approached the 90th percentile.

At 2400, the initial attack IC made the decision to evacuate the threatened community of Foresta and ordered Type 1 engines for structure protection. The effort succeeded, and the fire caused only minor damage within the community with no structures lost. The NPS ordered a Type 2 IMT, and the IMT assumed command at 1800 on August 27. Immediate efforts included closing two major roads within the park and evacuating Yosemite Lodge and the community of El Portal. The IMT's primary objective was to keep the fire from spreading into the Merced River Canyon, which would have resulted in a very large fire. When spread into the canyon appeared imminent, the NPS ordered a Type 1 IMT. The Type 1 team took over at 0600 on August 29, and received a joint letter of delegation from Yosemite National Park and the Stanislaus National Forest.

At the team's request, the Acting Park Superintendent approved the use of dozers, and fire personnel completed a dozer line on the fire's western flank by the end of the day on August 29. This decision and resulting action represented a turning point on the fire. From this point forward, the incident's complexity moderated. The Type 1 IMT transferred command back to a Type 3 IMT at 0600 on September 8 and the fire was declared contained at 1800 on September 9.

Figure 3: Big Meadow Fire Progression Map



Source: http://www.inciweb.org/incident/map/1869/1/

Major Cost Factors

Factors that <u>increased</u> costs:

1. *Structure Protection* – The protection of communities, both inside and outside Park boundaries, as well as Park infrastructure (including historical and cultural resources) required a heavy commitment of structure protection engines. Because the fire originated from an escaped prescribed fire, the NPS was responsible for all costs, a standard clause in Master Agreements, and paid for the structure protection engines
2. *Aviation Resources* – Heavy reliance on aviation resources, including airtankers, particularly early in the incident. The NPS cost review determined that retardant use early in the fire proved ineffective.

3. *Terrain/Access* – Steep terrain and roadless areas, including designated wilderness with equipment restrictions, limited access and therefore strategic options on parts of the fire.
4. *Location in Major National Park* – Actions taken to restore the park to its normal function as rapidly as possible contributed to fire costs. The park invested considerable resources in maintaining a law enforcement presence, re-opening the Big Oak Flat Road quickly, and maintaining resource levels sufficient to protect visitors while firefighting operations continued.
5. *State and Local Resources* – The use of local and state government personnel and equipment in California tends to cost more than similar Federal resources. Non-Federal structure protection resources resulted in substantial costs to the Big Meadow fire.
6. *National Catering Contract* – Incident personnel believed that, when below peak staffing, they could have reduced their food costs had they been able to use locally available food services rather than a nationally contracted caterer.
7. *Delayed Demobilization* – The IMT delayed the demobilization of some structure protection resources longer than outside observers might deem justified, to confidently allow visitors to re-enter closed portions of the park, while the IMT remained less than certain that the fire would not again threaten inhabited and visitor service areas. Overall, the NPS cost review found that the IMT had demobilized efficiently, guided by specific direction from the agency administrator.

Factors that decreased costs:

1. *Strategic Cost Containment* –The Acting Park Superintendent of Yosemite National Park and the Forest Supervisor of the Stanislaus National Forest emphasized cost management. The IMTs responded well by ordering judiciously and demobilizing resources quickly. One Deputy IC toured the incident base daily to identify excess resources for demobilization.
2. *Fuel Mitigation* – Extensive fuels modification conducted prior to the wildfire around the communities of Foresta and Old El Portal, as well as along the Big Oak Flat Road likely reduced the costs of structure protection and aided in fire containment.
3. *Helicopter Water Supply* – The use of heli-wells and portable dip tanks reduced flight time between drops, thereby reducing aircraft- related costs.
4. *Direct Transition to Type 3 IMT* – A timely, well-planned and well-executed transition from the Type 1 IMT to smaller, more cost-effective Type 3 team likely reduced costs.
5. *Bulldozers* – Despite location of the fire in a national park, the Acting Park Superintendent approved the use of bulldozers on the fire's western flank at the IMT's request, which likely reduced the fire's size and duration.

Findings

1. *Prescribed Fire Escape* – As described by the NPS's internal review of the incident, had Park personnel not ignited the Big Meadow prescribed fire or had they suspended burning operations once the fire began spotting over the line, and had the fire not escaped, $ 17M in fire suppression costs could have been avoided.
2. *Public Pressure* – National Park Service personnel faced tremendous pressure (both locally and nationally) to keep Yosemite National Park facilities open and operating. Closing popular parts of a national park, particularly during a major holiday weekend, has a dramatic economic impact on local communities surrounding the park.
3. *Delegation of Authority and Decision Support* – By making a single DOA to the IMTs and preparing a joint WFDSS, the line officers from Yosemite National Park and the Stanislaus National Forest improved decision-making and likely reduced fire suppression costs.
4. *IT Interoperability* – Lack of interoperability between NPS (Department of the Interior) and Forest Service (Department of Agriculture) computer systems resulted in inefficiencies and lost productivity that extended the duration of this fire by at least one day.
5. *Local Knowledge* – Local knowledge provided by unit personnel contributed to quality inputs into WFDSS, as did pre-loaded information about key natural resources, improving the effectiveness of early decision-making substantially. The P ark was also able to use local IMTs familiar with the area, terrain, fuels, and local resources. The IMTs' local knowledge appeared to lead to efficient operations, quality decisions, and likely reduced costs.
6. *Cost Share Agreements* – The Big Meadow fire was an escaped prescribed fire which, by policy, was therefore the sole financial responsibility of the NPS. Though the Stanislaus National Forest incurred significant costs, a cost sharing agreement was not appropriate.
7. *Cost Review* – The NPS conducted an excellent Regional Large Fire Cost Review using an interagency team. The review was comprehensive, thorough, and very well documented, and could serve as a model for Regional Large Cost Fire Reviews.

Knight Fire

Fire Data

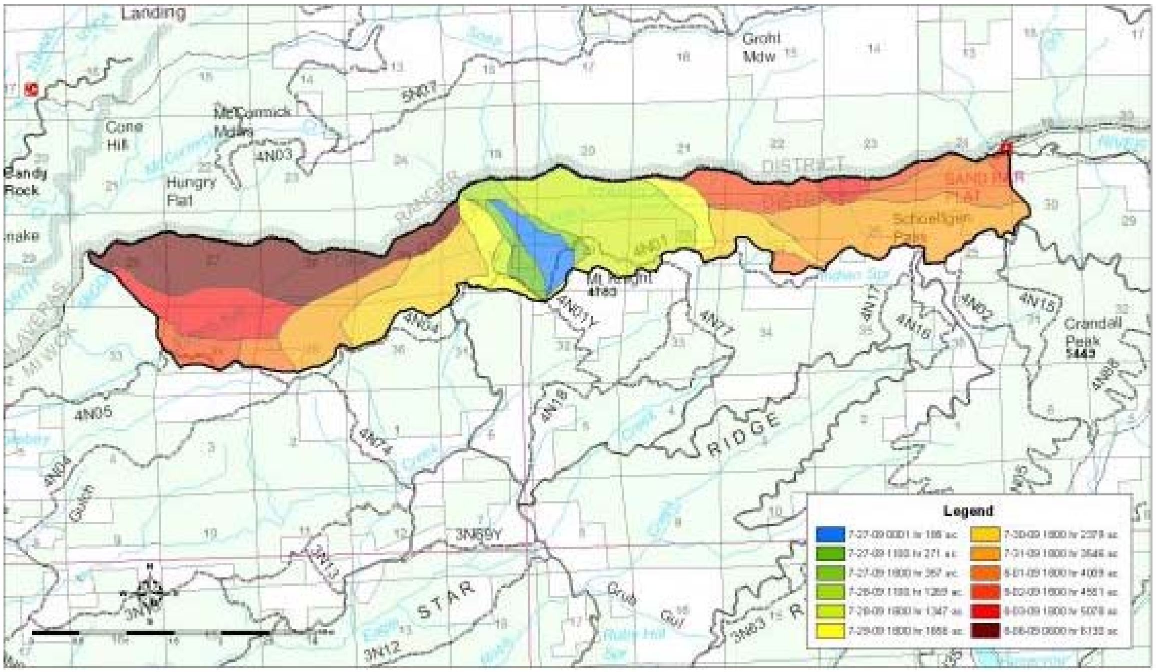
- **Fire Location:** Stanislaus National Forest, Tuolumne County, CA
- **Dates Burned:** July 26–August 19, 2009
- **Acres Burned:** 6,130
- **Estimated Cost:** $12,122,452
- **Peak Personnel Assigned:** 1,360

Fire Overview – The Knight fire began at approximately 1530 on July 26, 2009. The cause is still under investigation. Initial attack proved unsuccessful due to steep terrain and limited access, even though all programmed initial attack resources were available. The fire burned on a steep north slope on the south side of a river canyon, in fuels comprised of a pine overstory with a black oak and brush understory. Elevation change from the bottom of the fire to its top was more than 3,300 feet. High pressure dominated the weather, with seasonably high temperatures and low relative humidity for the first four days of the fire. On the morning of August 5 the weather pattern changed, bringing slightly lower temperatures, slightly higher relative humidity, and better nighttime humidity recovery.

The Forest ordered a Type 2 IMT that took command of the fire at 1800 on July 27. The Forest and the IMT placed priority on protecting the communities of Mt. Knight and Jupiter as well as reforestation investments made after the Ruby fire. The fire threatened approximately 35 residences, but none were lost. Given the difficult (rugged, steep, and rocky) terrain, the Forest and IMT selected a strategy to construct indirect fireline and burn out from the Stanislaus River to contain the fire between the ridge and the river, and allow the fire to burn both east and west until firefighters established safe and effective anchor points from which to construct additional fireline. The IMT entered into unified command with the California Department of Forestry and Fire Protection (CAL FIRE), who had direct fire protection responsibility immediately across the Stanislaus River to the north. CAL FIRE took contingency actions, including constructing fireline, in their protection area as a precaution, in case the fire crossed the river. The IMT successfully accomplished the strategy, and pinched-off both ends using 32.5 miles of a bulldozer-constructed fireline. This strategy required extensive burnout operations requiring significant air operations (including airtankers) to support the burning operations.

At 0600 on August 7 the IMT transferred command to a local Type 3 IMT. The Forest declared the Knight fire contained on August 19.

Figure 4: Knight Fire Progression Map (through August 6, 2009)



Source: http://www.inciweb.org/incident/map/1757/1/

Major Cost Factors

Factors that <u>increased</u> costs:

1. *Structure Protection* – 2009 policy would have allowed the Forest Service to protect structures from the threat of damage from an advancing wildland fire using standard wildland protection tactics, control methods, and equipment, including fire control lines and the extinguishment of spot fires near or on structures. However, protecting residences in the communities of Mt. Knight and Jupiter exceeded Forest Service capabilities, and required commitment of costly structure protection engines from the Tuolumne County Fire Department. Normally, one would expect that the County should have borne the cost of those efforts. However, the jurisdiction for Mt. Knight was unclear, and the Forest Service's Regional Director of Fire and Aviation Management ultimately determined that the Forest Service would pay the structure protection costs.
2. *Firefighter Safety* – Steep, rugged terrain and poor road access led to actions designed to provide for firefighter safety, including selection of an indirect strategy (which extended the duration of the incident) and staging an air ambulance (with paramedic) near the fireline during burnout operations in case the IMT needed to extract an injured fire fighter.
3. *Aviation Resources* – Limited road access and difficult terrain restricted the ability to use engines and increased the need for helicopters to drop water. In addition, the IMT needed to make significant use of aerially delivered retardant to support burnout operations.
4. *State and Local Resources* – The IMT necessarily used local and state government personnel and equipment that in California tend to cost more than similar Federal resources.

Factors that decreased costs:

1. *Local IMT* – The Stanislaus National Forest was able to use a local IMT familiar with the area, terrain, fuels, and local resources. The IMT's local knowledge appeared to lead to efficient operations, quality decisions, and reduced costs.
2. *Agency Administrator and IMT Actions* – The agency administrator stressed cost containment and the IMT responded well. Examples of cost saving measures included using gray water for dust abatement on roads, thereby saving the cost of ordering additional water trucks; using medical personnel to treat and clear patients on the incident, saving trips to the hospital; and the use of a private vendor satellite system enabling the IMT to use the two satellite company technicians (who came with the system) both to maintain their company's system, and also serve as incident communication technicians, thereby reducing the need for additional communication technicians.
3. *Demobilization* – The IMT handled demobilization very efficiently by releasing unnecessary resources immediately, after establishing release priorities to ensure that high cost resources were released first.

Findings

1. *Strategy Selected* – The availability of a local IMT and the lessons learned from the Darby fire in 2001 greatly enhanced the management of this fire. Early in the incident, the agency administrator, her staff, and the IC all had a good sense of what the fire was going to do, where it would spread, and where firefighters could stop it. The strategy selected seemed appropriate to the situation and was effectively executed.
2. *Wildland Fire Decision Support System* – The Forest ran WFDSS on July 27 and presented the results to the IMT during the in-briefing. Apparently, the Forest never updated their WFDSS analysis, and it quickly became obsolete. As a consequence, the Forest underestimated both the complexity and the final cost of the fire.
3. *Key Decision Log* – The decision makers involved in the Knight fire did not utilize the KDL process. Key Decision Logs facilitate the process of identifying, evaluating, and learning from key decisions.
4. *Air Operations* – The IMT considered their use of aerially delivered retardant on the fire's flanks and at the ridgeline as effective; and the Panel concurs. The IMT also made substantial use of helicopters, primarily to support burnout operations and line construction as well as to move crews. After day 7, the IMT's aircraft use dropped significantly.
5. *Fire Results* – The fire was contained in the desired area with no serious civilian or firefighter injuries. The Review Panel thought this was almost a textbook case of well-considered strategic choice at the agency administrator level which was well-communicated to IMTs.
6. *Cost-share Agreements* – The Forest signed a cost-share agreement with CAL FIRE as a contingency in case the fire spotted across the Stanislaus River to the north and into CAL FIRE jurisdiction. As a precaution, CAL FIRE decided to take contingency actions north of the river and paid for all the costs. At the time

the cost share agreement was struck, the Forest Service and CAL FIRE could not agree on who should pay for two CAL FIRE/Tuolumne County engine strike teams which responded on initial attack or provided structure protection on the first three days of the fire. The agreement deferred determination of responsibility for these costs to the Forest Service Region 5 Director of Fire and Aviation Management.

La Brea Fire

Fire Data

- **Fire Location**: Los Padres National Forest, Santa Barbara County, CA
- **Dates**: August 8–September 20, 2009
- **Acres Burned**: 89,489 acres
- **Estimated Cost:** $34,888,910
- **Peak Personnel Assigned**: 2,152

Fire Overview – The La Brea fire began on August 8 in the mid-afternoon, and within three hours grew to 1,200 acres. The fire originated on steep and inaccessible terrain in the San Raphael Wilderness under fire conditions including hot temperatures, low relative humidity and winds that supported long range spotting.

The initial attack forces could not contain the fire, and used heavy air support in an attempt to slow its spread. More than 360 firefighters were assigned within the first four hours.

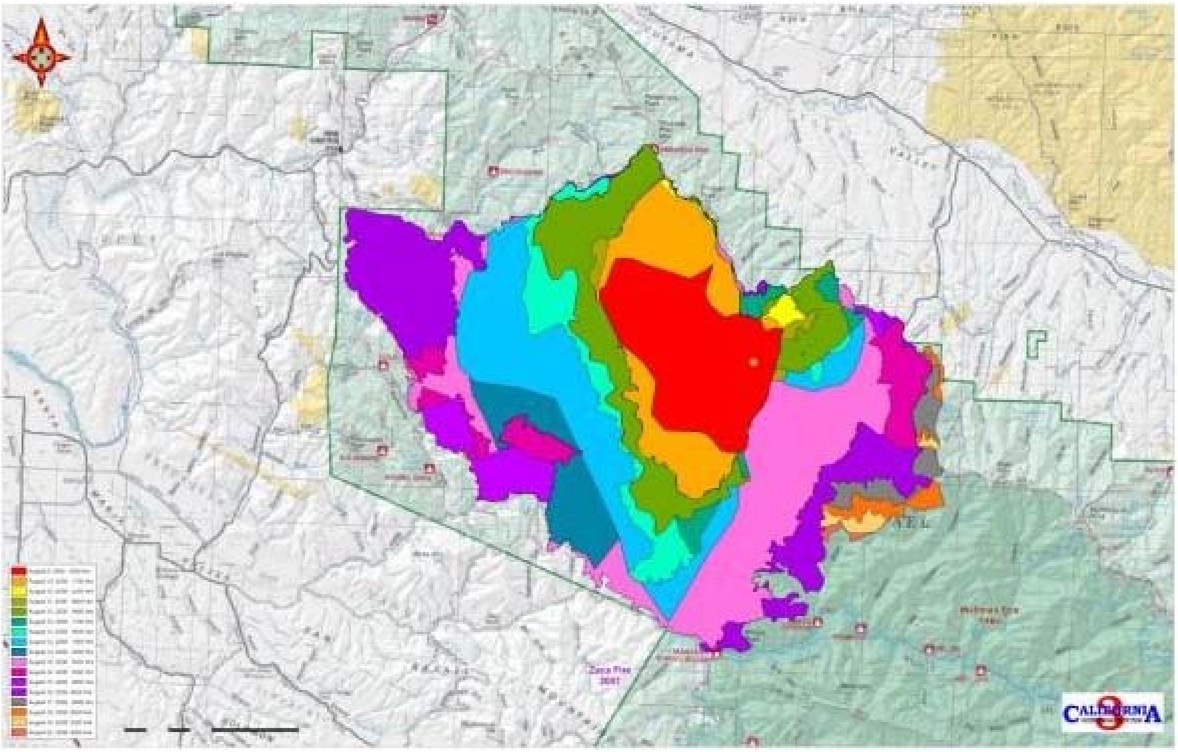
The Forest ordered a Type 1 IMT within six hours of the fire's start, and the IMT assumed command on August 10. The Forest also ordered a NIMO team as advisors to the Forest Supervisor.

The IMT utilized dozer fire lines from earlier fires, and extensive prescribed burn areas from 2007 and 2009, in their suppression effort. The fire threatened more than 250 residences and outbuildings in adjacent WUI areas, but only two structures were lost. The fire made several significant runs in the first 10 days, adding thousands of burned acres.

Safety concerns and long travel distances to the fire from the incident command post necessitated the use of spike camps for firefighters as well as occasional coyote tactics, where the firefighters actually camp on or very close to the fireline for two to three days at a time. The need to support remote camps resulted in extensive use of helicopters.

Moderating weather conditions allowed for a more aggressive suppression strategy without compromising firefighter safety, and the IMT declared the fire contained on August 22, and they turned command over to a Type 2 IMT on August 23. Because of its large size and the potential for several more months of active fire season, the Forest staffed the fire until September 20.

Figure 5: La Brea Fire Progression Map (August 20, 2010)



Source: http://www.inciweb.org/incident/map/1803/1/

Major Cost Factors

Factors that increased costs:

1. *Steep Slopes/Limited Access* – The steep slopes, inaccessible nature of the area, and formal wilderness designation required the extensive use of Type 1 handcrews.
2. *Heavy Fuels* – The long period of absence of wildfire in much of the area created heavy Chaparral fuels that readily burned at a high intensity, threatening to leave the National Forest and burn onto adjacent private lands.
3. *Aviation Support to Spike Camps* – Long travel distances to the immediate area necessitated the establishment of spike camps, which then required costly aircraft resources to support the firefighters staying in those camps.
4. *Structure Protection* – The presence of numerous residences and other structures in the path of the fire's spread led to the significant use of engines and water tenders. According to the IC, CAL FIRE paid for structure engines and Santa Barbara Co. paid all of their own costs. Assuming that the Forest Service paid for no structure protection engines in CAL FIRE/Santa Barbara County jurisdiction, the arrangement appears to be consistent with Forest Service policy.
5. *State and Local Personnel* – The use of non-Federal resources resulted in high direct personnel and equipment costs as local and state government personnel and equipment in California tend to cost more than similar Federal resources.

6. *Direct Protection Area Boundary* – The boundary separating the jurisdiction of the Los Padres National Forest from that of Santa Barbara County/CAL FIRE lay mid-slope, and proved very difficult to defend. The desire of Santa Barbara County to keep the fire confined to the National Forest and off the state responsibility area (SRA), for which the county contracts, caused resistance to suppression strategies that would have allowed the fire to spread across that boundary to a point where firefighters could engage the fire more easily.
7. *Ordering Strategy* – In an effort to reduce costs during extended attack, the Forest ordered only Federal resources to support the Type 3 IMT. As a result, suppression resources were slow to arrive. Many of the Federal personnel were at the end of their maximum length of assignment and had to be immediately replaced. This may have compromised the strategy of the IMT and led to a longer duration incident.
8. *Aviation Resources/Retardant Use* – The Type 1 IMT relied heavily on aerially delivered retardant throughout the incident at a cost of over $4.8M. The La Brea fire appeared unusually, and somewhat disproportionately reliant on retardant when compared to the other fires reviewed.
9. *Delayed Demobilization* – The Forest chose to staff the fire for almost one month after containment.

Factors that <u>decreased</u> costs:

1. *Adaptable Fire Management* – Close monitoring of weather and burning conditions allowed a more aggressive suppression strategy that reduced potential burned acres and shortened the time needed for managing the fire with a Type 1 IMT.
2. *Aviation Cycle Time* – Aircraft operations were based as close to the ongoing incident as feasible, reducing flight hours and costs.
3. *Existing Firelines and Fuel Breaks* – Use of existing fuel breaks and firelines from fires in the immediate area over the past 3–5 years reduced labor required to cut new firelines, and hence costs and acres burned.
4. *Aerial Retardant Support of Firefighters* – Later in the fire, once large numbers of handcrews were on the fire line, the IMT coordinated aerially-delivered retardant with crew action to support and enhance line-building capacity, ultimately reducing the duration of the fire.

Findings

1. *Initial and Extended Attack* – The initial attack and extended attack efforts were appropriate and as planned for such a fire start. They ultimately proved unsuccessful due to fire behavior and high resistance to control influenced by the terrain and long-term buildup of Chaparral fuels.
2. *Agency Administrator/IMT Relationship* – During the incident, the relationship between the Type 1 IMT and agency administrators broke down, in part over the role of the NIMO team on the incident and in part over the strategy for the fire's eastern flank. This situation proved less than ideal, and resulted in some confusion and conflicting direction that likely increased cost.

The un-coordinated use of a NIMO Team and a Type 1 IMT proved ineffective and inefficient. The NIMO Team's role and responsibilities were not well defined. The controversy over strategy involved disagreement over whether to allow the fire's eastern flank to spread versus taking aggressive suppression action on it. Ultimately, the IMT took suppression action on the fire's eastern flank, shortening the fire's size and duration. However, the Panel could not ascertain whether the fire's reduced size and shortened duration offset the costs of the resulting suppression action, which involved extensive aircraft use, or the costs of delays caused by the confusion resulting from the issues surrounding relationships, roles and responsibilities.

3. *Agreements between Federal and Non-Federal Entities* – While unified command was established with Santa Barbara County/CAL FIRE; inefficiencies resulted from a lack of pre-season agreements governing cost-sharing and other important cooperative arrangements. Santa Barbara County pulled resources off the fireline, at one point, over agreement-related concerns.

4. *Use of Handcrew and Aircraft Resources* – The location of the fire and the nature of the terrain, along with administrative designations (wilderness) mandated the extensive use of handcrews and aircraft in their support, rather than the use of mechanical equipment.

5. *Environmental Costs versus Fire Costs* – A major consideration in the choice of strategy was to reduce damage to the watershed, in order to mitigate flooding of nearby communities from water runoff after the fire. Letting the fire burn would have reduced costs of the fire but increased the flooding threat after the fire. Likewise, there was concern about shortening the fire's duration by using retardant versus contaminating water sources with retardant. Some requests for retardant drops were rejected by the Forest Supervisor. These were difficult cost-effectiveness choices.

6. *Cost-share Agreement* – The Los Padres National Forest signed a very brief, but specific cost-share agreement with CAL FIRE that stated each party would essentially pay for resources that it ordered, and would remain responsible for the cost of its own resources within its own jurisdiction. CAL FIRE and Santa Barbara County, as CAL FIRE's contractor, paid for all structure protection costs within their jurisdictions.

Station Fire

Fire Data

- **Fire Location:** Angeles National Forest, Los Angeles County, CA
- **Dates Burned:** August 26–October 5, 2009
- **Acres Burned:** 160,577
- **Estimated Cost:** $94,739,316
- **Peak Personnel Assigned:** 5,244

Fire Overview – The Station fire started at approximately 1520 on August 26, adjacent to Highway 2 on a steep west-facing slope above the City of La Canada. Arson was the suspected cause.

The initial attack dispatch occurred at 1524, with simultaneous response by both the Los Angeles County Fire Department and the Angeles National Forest. Resources included 9 20-person handcrews, 13 engines, 3 water tenders, 2 patrols, 1 light helicopter, 2 medium helicopters, 4 heavy helicopters, 2 airtankers, an air attack aircraft, and 4 chief officers. The IMT managing the nearby Morris fire provided some of the responding air resources.

The fire started on rugged and steep terrain, with several narrow, east-facing ravines along the highway. The slopes from the highway to the creek bottom range from 33%–67%, and from 900–1,680 feet in length. The fire started in mature mixed Chaparral at least 50 years old that stood six to eight feet tall and was extremely flammable.

The weather was hot and dry with temperatures approaching 100 degrees and relative humidity standing at less than 10%. A light wind was blowing. The fire exhibited extreme fire behavior, including spotting. A long-standing drought and lack of recent precipitation, aggravated by the steep topography, made for very dangerous burning conditions.

The initial attack succeeded at first; arriving forces contained spot fires both above and below the road, and firefighters believed they could hold the fire to 15 acres.

However, one spot fire below the road occurred in a location that ground crews could not reach, and air resources alone could not extinguish it. By 08:30 on August 27, fire burned both above and below the road, and firefighters faced 35 mph winds and extreme fire behavior.

At approximately 1310, Los Angeles County and the Angeles National Forest established unified command. At 1332, they ordered a Type 1 IMT. The IMT assumed command at 1400 hours on August 28. The National Weather Service issued Red Flag Warnings on both August 27 and 28 for combined high temperature and low relative humidity.

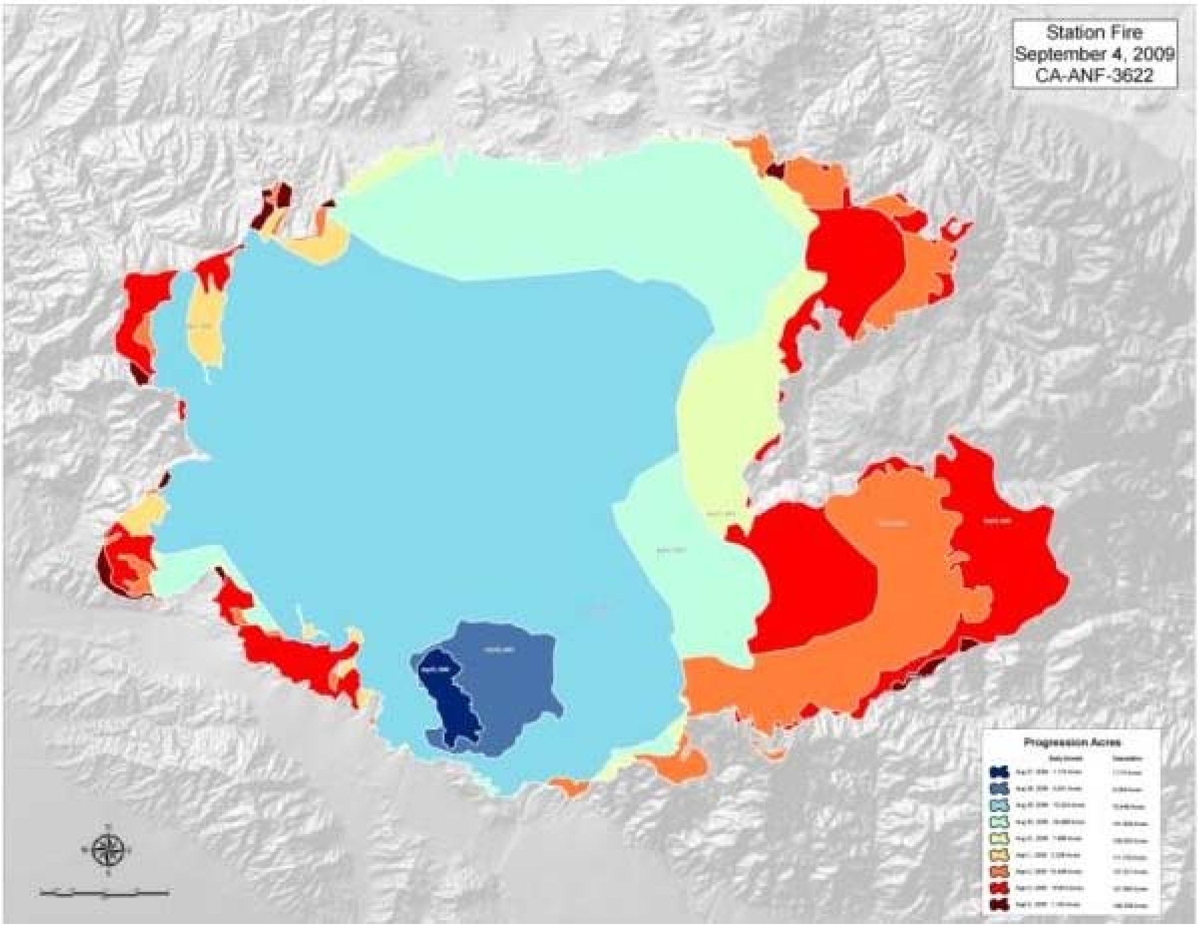
The fire made significant runs on both August 29 and 30 primarily driven by fuels and topography. A combination of an unstable air mass and extreme fire behavior also produced plume-dominated fire behavior, which occurs when the energy produced by the fire in conjunction with forces such as atmospheric instability create convective forces that dominate the surrounding environment. The fire also produced frequent spotting one-two miles ahead of its main body every day from August 28 to September 8. There were several extremely dangerous smoke column collapses.

The initial strategy, after the fire escaped, focused on structure protection in WUI areas threatened by the fire, and protecting multiple communication sites and the observatory on Mt. Wilson. Fire officials estimated the value of threatened built infrastructure (including homes in the WUI and the Mt. Wilson Observatory) at more than $1B. The fire area includes the main watershed for the City of Los Angeles. The Forest and IMT pursued a major objective of allowing the fire to move up into the forest and wilderness areas, away from the WUI, by primarily employing an indirect strategy.

The IMT frequently and extensively used airtankers throughout the incident. At the peak of the fire the IMT employed 23 helicopters and 12 airtankers, including three VLAT. Los Angeles County managed extensive evacuations from multiple areas around the fire. The fire burned 89 residences, 26 commercial properties, and 94 outbuildings. Fire Captain Ted Hall and Firefighter Specialist Arnie Quinones perished when their engine went off the road and they were burned over as they fought to protect the Los Angeles County Fire Department's Camp 16, which was destroyed by the fire.

The weather pattern changed after September 4 and the marine layer reformed, bringing lower temperatures and higher relative humidity. This enabled the IMT to successfully control the west flank and shift to direct attack along one ridge, a decision that likely reduced the final fire size by 30,000–50,000 acres and contributed significantly to containment. On September 12, the Forest ordered a Type 2 IMT to replace the Type 1 IMT and continued suppression efforts. The Type 2 IMT assumed command at 0600 on September 15. The IMT turned the fire back to the Angeles National Forest on September 28 and the Forest declared the Station fire 100% contained on October 5.

Figure 6: Station Fire Progression Map (September 4, 2009)



Source: http://www.inciweb.org/incident/maps/1856/

Major Cost Factors

Factors that <u>increased</u> costs:

1. *Protection of Structures and Built Infrastructure* – Urban areas, including part of the City of Los Angeles, surround the Angeles National Forest. The IMT estimated the value at risk as $1B. Type 1 structure engines and airtankers used to protect the structures contributed significantly to costs.

   The fire area included the Mt. Wilson Observatory, which hosts several of the most technologically advanced facilities in the world for studying astronomical objects. Critical communications structures also occupy the Mt. Wilson site. The IMT estimated that they spent $14M–$17M protecting the Mt. Wilson site alone.

2. *Firefighter and Public Safety* – Steep, rugged terrain and limited road access, combined with urban traffic congestion surrounding the Forest, required actions to provide for firefighter safety, and contributed to the Station fire's high cost. In addition, public safety concerns led to large scale evacuations from the Forest and surrounding communities, which involved approximately 1,000 law enforcement personnel.

3. *Aviation Resources* – The IMT used airtankers and heavy helicopters throughout the incident, mostly owing to extraordinarily high values at risk, intense public interest and expectations, and steep, rugged terrain. Of the total $16M spent on aircraft, airtankers and retardant accounted for more than $7.5M, and heavy helicopters another $5M.
4. *Political Pressures/Very Large Airtankers* – Because of political pressure from outside the agency, the Forest and the IMT agreed to order two DC-10 VLATs. In addition, CAL FIRE ordered and paid for the 747 VLAT. Retardant delivered by the DC-10s cost $33K per drop and the 747 $148K per drop. Angeles National Forest fire officials stated they would not have ordered these aircraft if they weren't pressured to do so.
5. *State and Local Resources* – The Station fire ultimately used a great deal of local and state government personnel and equipment. In California, these resources typically cost much more than similar Federal resources.
6. *Ordering Federal Resources* – In early 2009, the Forest Service's Pacific Southwest Region issued a guidance letter interpreted in the field to mean that the Forests should order Forest Service personnel and equipment before ordering state or local resources. The Regional Forester intended this guidance to reduce fire suppression costs. However, the decision on the Station fire to initially order only Federal personnel delayed arrival of critical resources. For example, the nearby Morris fire released a strike team of CAL FIRE engines who returned to San Diego while an order for a Federal strike team of engines for the Station fire remained unfilled.
7. *Political Pressures and Social Expectations* – An estimated 15 million people live in the Los Angeles Basin. The Angeles National Forest adjoins 26 Congressional Districts. Numerous newspapers, television stations, and other media outlets cover news in the area. Fires in the Los Angeles Basin generate intense public interest, resulting in tremendous pressure on agency administrators and IMTs to do everything possible to stop a wildfire, including taking actions that one would describe as either fiscally imprudent or not likely to succeed, including continuous use of aerially delivered retardant. In addition, the intense public and media interest required the IMT to take extraordinary public affairs measures, including staffing a 24 hour/7 day per week information center.
8. *Direct Protection Area Boundary Location* – The Angeles National Forest boundary falls at mid-slope on some parts of the Forest. Working with their cooperators, the Forest relocated the DPA boundary in order to create a more logical boundary for wildfire protection, one that conforms better to natural terrain. Consequently, the Angeles National Forest now provides direct fire protection to lands historically protected by CAL FIRE. While this makes sense from a jurisdictional perspective, it had the adverse effect of making the Forest responsible for expensive structure protection on private lands.

Factors that <u>decreased</u> costs:

1. *Local IMT* – A local IMT familiar with the area, terrain, fuels, and local resources managed the Station fire, enabling quality decisions and efficient operations that likely contained costs.

2. *Incident Management Team Actions* – Although this was an extremely costly wildfire, we saw evidence that the IMT took steps to limit costs. For example, the IMT established three base camps and two spike camps to reduce travel times on congested highways; used the same sleeping vans for both the day and night shifts, lowering the cost to $23/person/bed; and aggressively demobilized excess resources.
3. *DC-10* – Though the DC-10 VLATs are very expensive to operate, the IMT used them to stop the fire along a ridge with 31 drops. This action cost more than $1M, but likely reduced the fire's duration, saving approximately $6M–$8M.
4. *Bulldozers* – Unlike other national forests, the Angeles' wilderness legislation codifies bulldozer use in designated wilderness areas. The Forest Supervisor pre-approved the use of dozers for wildfire suppression on the Forest, which enabled their speedy use on this fire.

Findings

1. *Incident Management* – The Station fire represented a very large, complex incident, in rugged terrain, involving multiple jurisdictions at the edge of the City of Los Angeles. Fire personnel faced extraordinary challenges. However, the agency personnel, including agency administrators who were actively engaged, handled the situation as well as one might expect given the circumstances. The fact that the IMT came from southern California and had experience with this type of high profile fire proved advantageous.
2. *Initial Response* – Controversy continues over whether Forest personnel could have stopped the fire on the morning of August 27 (day 2). Critics claim that if the Forest had airtankers and heavy helicopters on station over the incident at first light, they may have stopped the fire's spread. If true, more than $90M in cost could have been avoided. However, the Forest Service, Los Angeles County, and CAL FIRE jointly reviewed the initial and extended attack. Their report, issued on November 13, 2009, found that the initial attack ICs acted appropriately and made prudent decisions regarding the safety of firefighters, including those involved in air operations. Further, the report determined that aggressive air operations in the early daylight hours of day 2, without necessary ground support, would not have been effective. The matter remains under investigation and, therefore, beyond the scope of this Panels' review.
3. *Wildland Fire Decision Support System* – The Forest's first WFDSS run presented an overly optimistic scenario that proved less than useful. A later run essentially documented, after the fact, what had happened on the incident and estimated costs fairly accurately.
4. *Public and Political Interest* – Large fires in densely populated areas such as the Los Angeles Basin generate incredible public, political, and media interest. This interest puts tremendous pressure on agency administrators and IMTs to make decisions they might not normally make in order to satisfy the public and their elected officials who insist that they do everything possible to put the fire out. This includes excess and unwarranted aerially delivered retardant, which quickly and significantly adds to the fire's overall cost, often without clearly benefitting fire control efforts.

5. *Cost-share Agreements* – The Angeles National Forest worked closely with neighboring jurisdictions (including CAL FIRE and Los Angeles County Fire) to establish a cost-share agreement in accordance with CFMA. The agreement stated that each party would pay for resources that it ordered, and was responsible for the cost of its own resources within its own jurisdiction. The Los Angeles County Sheriff and surrounding law enforcement agencies paid their own costs. CAL FIRE agreed to pay for the 747 VLAT, and Los Angeles County paid for the structure protection engines. Other parties to the agreement included the Los Angeles City Fire Department, Pasadena City Fire Department, and Glendale City Fire Department.

6. *Fire Outcome* – The Station fire was by far the most costly fire of 2009, costing more than the next five most costly fires combined. However, the $94M fire suppression effort likely saved more than $1B in property, and prevented enormous disruption to communications and TV, and loss of national astronomical assets.

Williams Creek Fire

Fire Data

- **Fire Location**: Umpqua National Forest, Douglas County, OR
- **Dates**: July 28–August 16, 2009
- **Acres Burned**: 8,395 acres
- **Estimated Cost:** $14,226,246
- **Peak Personnel Assigned**: 1,118

Fire Overview – The Williams Creek fire began beneath a powerline on July 28 at approximately 1300. Fire conditions were extreme, with temperature at 104°F and relative humidity as low as 4%. Access to the fire area was difficult, and the fuels included heavy brush and timber.

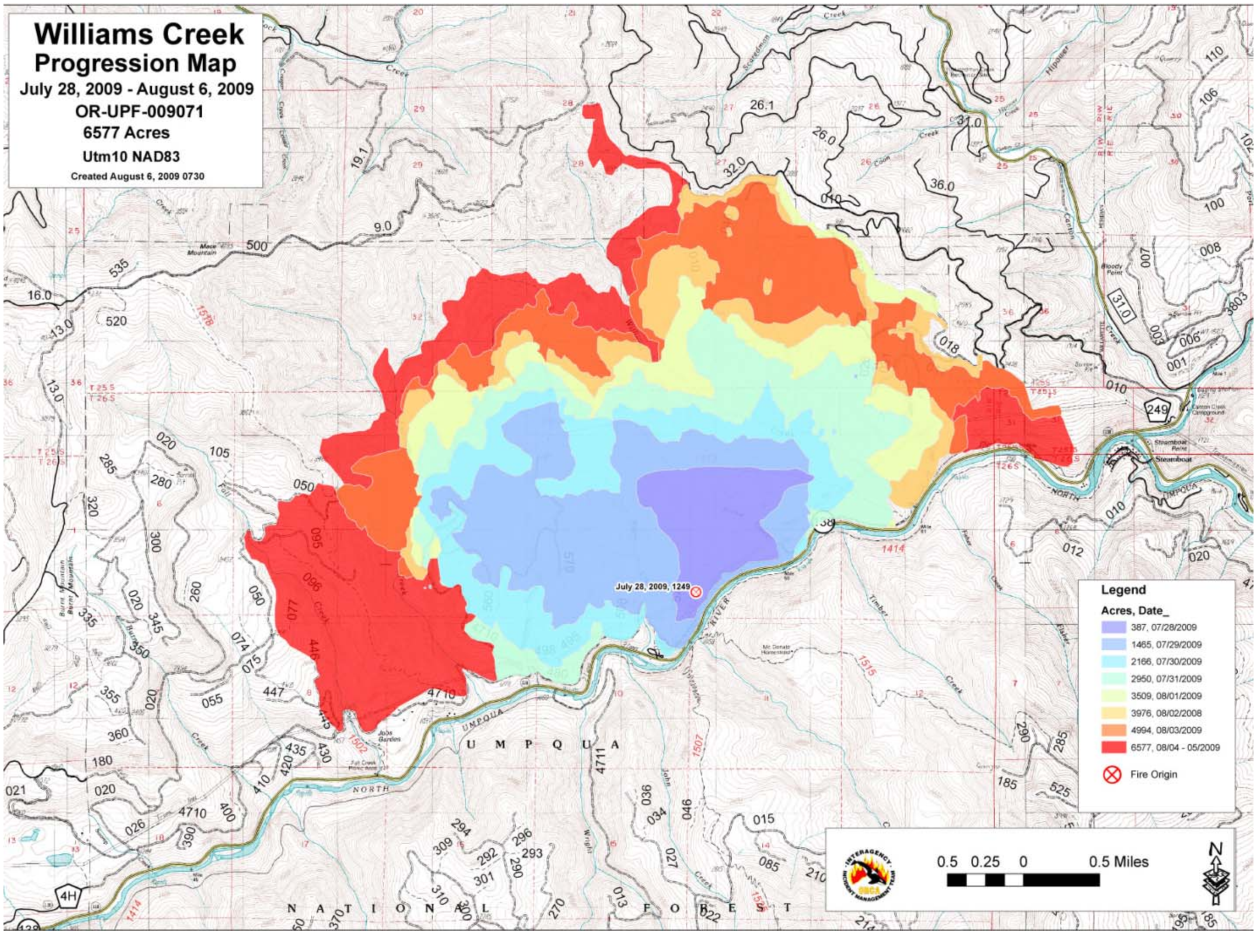
The Forest ordered a Type 2 IMT by 1900 hours on July 28, and assumed unified command with the Douglas Forest Protection Association (DFPA), a private forest protection association and adjunct of the Oregon Department of Forestry (ODF), at 0600 on July 30. The Forest also ordered a NIMO team to complete a long-term assessment of the fire's potential, which was completed on July 31.

Weather conditions moderated over the next few days, allowing the IMT to succeed with a strategy of indirect attack and burnout.

The fire remains under investigation, but if the Forest determines that this fire was person-caused, cost recovery may represent a possibility with the potential of recouping some or all of the government's $14M suppression expenditure.

Command of the Williams Creek fire was transferred back to a Type 3 IMT on August 17.

Figure 7: Williams Creek Fire Progression Map



Source: http://www.inciweb.org/incident/map/1763/1/

Major Cost Factors

Factors that <u>increased</u> costs:

1. *Firefighter Safety* – The steep slopes, heavy fuels and inaccessible nature of the area precluded the use of direct attack, since firefighter safety could not be assured.
2. *Aviation Resources* – The IMT required air support to move suppression personnel due to the limited access.
3. *Private Timberland* – Privately-owned, high value commercial timberland immediately adjacent to the fire area directly influenced the fire suppression strategy and limited options for allowing the fire to spread.
4. *Structure Protection* – Private and government-owned structures threatened by the fire required numerous engines for structure protection activities. Structure protection involved a joint effort between the IMT, local fire departments and the Douglas County Sheriff's Office. Consistent with Forest Service Policy and the Operating Agreement between the Forest Service and ODF, the fire departments and Count Sheriff's Office covered their own costs.

5. *Major Powerline* – The presence of high voltage transmission lines restricted air activities and access by ground crews during the early stages of the fire. Incident personnel gave much thought to protecting the flow of electricity as the burning occurred around the power line right-of-way.

Factors that decreased costs:

1. *Local Cooperation* – Agreements with adjacent private timberland owners allowed a suppression strategy that reduced acres burned and the fire's duration.
2. *Adaptable Fire Management* – Careful attention to changes in fire and weather conditions allowed the IMT to switch to more aggressive control actions several days earlier than originally anticipated, reducing both the fire's size and duration, which resulted in significant cost savings.
3. *Well-managed Retardant Use* – Incident personnel made nearly textbook use of retardant on this fire, employing airtankers during initial attack and when firefighters on the ground could follow-up the aerially delivered retardant, then sharply curtailing retardant use after that.

Findings

1. *Initial and Extended Attack* – The initial attack and extended attack efforts were appropriate and as previously planned, although unsuccessful.
2. *Unified Command* – The Forest and DFPA managed the fire under unified command. The united direction facilitated effective decisions that helped contain fire costs.
3. *NIMO Team* – The use of a NIMO team to provide a long-term assessment of the fire's potential growth resulted in effective decisions that lowered total fire costs, by framing appropriate suppression strategies and tactics.
4. *Cooperation with non-Federal Entities* – The close coordination between Federal, and private landowners, as well as between the Forest, DFPA and ODF, ensured cost-efficient operations.
5. *Regional Review Process* – The Forest Service's Pacific Northwest Region employs a unique cost review process. The Regional Forester appoints a team of experienced specialists and line officers to review and evaluate the Forest Supervisor's management direction, and make recommendations to the Regional Forester. This process appears to improve the decision-making, business practices, and cost consciousness of the Forest and the IMT.
6. *Infrared Use* – Infrared cameras mounted on fixed wing aircraft (air attack platform) allowed firefighting to continue despite heavy smoke. The IC felt this was critical to success as it provided an unobscured view of the fire's location, and allowed continuation of air operations, which allowed ground crews to continue working. Without IR capability the IMT would have been forced to curtail air operations and withdraw crews from the fireline, losing productivity and driving up fire costs. The cost of the IR- capable air attack platform is higher than alternatives, but the investment in higher contract costs seemed more than off-set by greater productivity and safety.

7. *Road Closure* – The fire threatened the closing of a major Cascade Mountain crossing, which was in high demand for summer recreation. Fire personnel were influenced by public pressure to re-open the road.

8. *Cost-share Agreements* – The Forest signed a cost-share agreement with the Douglas Forest Protection Association in accordance with the Master Cooperative Fire Protection Agreement. The agreement stated that each party would pay for fire suppression costs would be divided on a percentage of acres burned in each organization's jurisdiction. The agreement further stated that the DFPA maintained responsibility for fire suppression on State, Bureau of Land Management and private lands within the Douglas District, while the Forest Service retained responsibility for Forest Service Lands. However, the cost share agreement listed major caveats. First, since the unified command selected a strategy that placed containment lines on private industrial timber land protected by DFPA, and that strategy was in the Forest Service's interest, the Forest Service agreed to bear the cost of implementing that strategy. Second, if DFPA were to act outside the chosen strategy and incident action plan in order to address constituent concerns, the DFPA would bear the costs.

Summary of Cost Factors

Table 2 shows the key cost factors that the Panel noted for each fire. For this analysis we included both our findings pertaining to individual fires as well positive and negative cost factors we noted. As can be seen, several cost factors influenced most of the large cost fires, though to various degrees. Each fire had multiple factors driving up costs and multiple factors tending to decrease costs.

Many cost factors driving costs upward are beyond the control of incident personnel. When combined with the Panel's cost analysis, this analysis provides the basis for the Panel's findings and recommendations

Table 2: Factors/Findings Affecting Cost in Large Cost Fires in 2009

Factors/Findings	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Factors Increasing Costs						
Rough Terrain	X	X	X	X	X	X
Steep Slopes	X	X	X	X	X	X
Limited Access	X	X	X	X	X	X
Heavy Fuels	X	X	X	X	X	X
Structure Protection		X	X	X	X	X
Private Timberland	X					X
Aviation Resources	X	X	X	X	X	X
State/Local Personnel	X	X	X	X	X	
Public/Political Pressures	X	X		X	X	X
Firefighter Safety	X	X	X	X	X	X
Delayed Demobilization		X		X		
DPA Boundary				X	X	X
Resource Ordering				X	X	
Road Closure Affecting Economy		X			X	X
Other Significant Factors		National catering contract Lack of IT Interopera bility		AA/IMT disagree-ment Lack of local agreement		Major power line

Factors/Findings	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Factors Decreasing Costs						
Local IMT Knowledge		X	X		X	X
Fuel Mitigation		X		X	X	
Adaptable Fire Strategy	X			X		X
Interforest/Interagency Cooperation	X	X		X	X	X
Cost Containment Emphasis	X	X	X	X	X	X
Rapid Demobilization		X	X			
Early Use of Bulldozers		X	X	X	X	
Efficient Selective Air Operations	X		X			X
Other Significant Factors		Helicopter water supply Direct transition to IMT-3		Reduced Aviation Cycle Time Aerial retardant support of fireline	Use of DC-10 VLAT	IR use for fire locations Local agreement with private timberland owner

Notes:

- These factors were especially noteworthy in the fires flagged. Some factors may also apply to other fires.
- Firefighter safety was sometimes an explicit and sometimes an implicit factor contributing to cost (e.g. implicit when it led to indirect fire control strategy).

CHAPTER III. COST ANALYSIS

To obtain more insight into the costs of each fire, the Panel undertook a variety of comparative financial analyses. We used the results to help guide the Panel's review. The cost analysis contained here provides part of the foundation on which the Panel's findings and recommendations rest.

Cost Data Sources

The Panel primarily based the analyses here on costs reflected in the I-Suite data base. The Panel obtained additional cost information from the Forest Service financial system and other documents provided by both Forest Service and NPS staff during our site visits.

I-Suite – I-Suite is an interagency application provided to manage and track information in the incident business management functions. Incident management personnel track daily incident costs by inputting cost data into I-Suite, and the data can consist of estimates or actual costs. Forest Service representatives expert with I-Suite said that I-Suite data typically represents most, if not all the costs associated with a fire incident. However, in some cases, I-suite does not reflect costs borne directly by cooperators, and these can prove significant, as IMT personnel said they were on the Station fire.

I-Suite divides costs into either direct or indirect costs and then into specific cost categories, such as Handcrews, Aircraft, and Supplies/Services, and sub-categories such as Handcrews – Type 1, Airtanker, Supplies and Caterer. Direct costs are those related to personnel, aircraft, and equipment that are part of fire fighting operations. Indirect costs are those related to personnel, supplies, and services that support the operations personnel. The indirect costs include logistical support and finance staff, supplies, catering, camp crews, etc. The I-Suite cost information is the only source that accounts for an incident's costs on a daily basis, and provides the only practical starting point for analyzing and comparing incident costs.

Incident personnel use I-Suite to document and track costs, but who pays those costs is another matter. Costs sharing agreements arranged before or during an incident determine which agency will pay which costs.

Caveat: Inconsistent Cost Classifications – The panel found some inconsistencies in the classification of incident costs for the six fires we reviewed. For example, I-Suite listed retardant costs for two fires as zero, even though the IMTs made considerable use of retardant. In these cases, Cost Unit personnel included retardant costs as part of aircraft costs rather than indentifying them separately. In another example, Cost Unit personnel classified mobilization and demobilization costs as "other support." In another example, buying team wages were classified under supplies rather than indirect personnel. Although these misclassifications likely did not change the overall costs for the fire or for the category, people managing and reviewing fire costs require consistent cost classification if they are to determine the reasonableness of the costs and make cost comparisons among incidents without having to go into the detailed billing files.

Despite the data inconsistencies, the Panel remains confident that the data provided a sufficient basis for the level of analysis required, and that our analysis reflects an adequate understanding of the costs of these fires.

Overall Costs of Fires

Taken together, the six fires reviewed cost nearly $190M to suppress. Table 3 shows the costs by major I-Suite category for each fire. The costs associated with each fire depended on the strategies and resources used to contain the fire given the weather conditions, terrain, type of fuels, size of the fire, number of days needed to contain the fire, resources available and their source, community concerns, and the potential areas at risk. (Chapter II discusses these factors for each fire.)

Table 3: Total Costs by Fire and I-Suite Category

Fire	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
La Brea	$10,163,512	5,012,846	8,251,079	1,277,487	**24,704,924**	6,896,420	3,287,566	**10,183,986**	**$34,888,910**
Backbone	4,915,801	219,799	4,763,581	1,000,367	**10,899,548**	3,735,298	2,262,904	**5,998,202**	**16,897,750**
Big Meadow	3,823,544	3,765,184	3,106,866	1,086,623	**11,782,217**	2,728,834	2,436,193	**5,165,027**	**16,947,244**
Knight	2,197,253	2,252,655	2,704,880	950,919	**8,105,707**	2,403,222	1,613,523	**4,016,745**	**12,122,452**
Station	16,033,893	25,615,077	17,636,100	3,506,769	**62,791,839**	18,686,110	13,261,367	**31,947,477**	**94,739,316**
Williams Creek	2,159,574	2,279,126	4,394,112	1,346,323	**10,179,135**	2,966,181	1,080,929	**4,047,110**	**14,226,245**

The two most costly fires, La Brea and Station, lasted 44 and 41 days, respectively. The other four fires lasted 20–25 days.

In the interest of understanding the composition of fire costs by fire and across fires, the Panel compared the percentage of fire costs by I-Suite major cost category, as shown in Table 4. This analysis established a cost profile for each fire, identified major differences between fires, and established the basis for further exploring variations in cost profiles.

Table 4: Percentage of Costs by I-Suite Category

Fire	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
La Brea	29%	14%	24%	4%	71%	20%	9%	29%	100%
Backbone	29%	1%	28%	6%	65%	22%	13%	35%	100%
Big Meadow	23%	22%	18%	6%	70%	16%	14%	30%	100%
Knight	18%	19%	22%	8%	67%	20%	13%	33%	100%
Station	17%	27%	19%	4%	66%	20%	14%	34%	100%

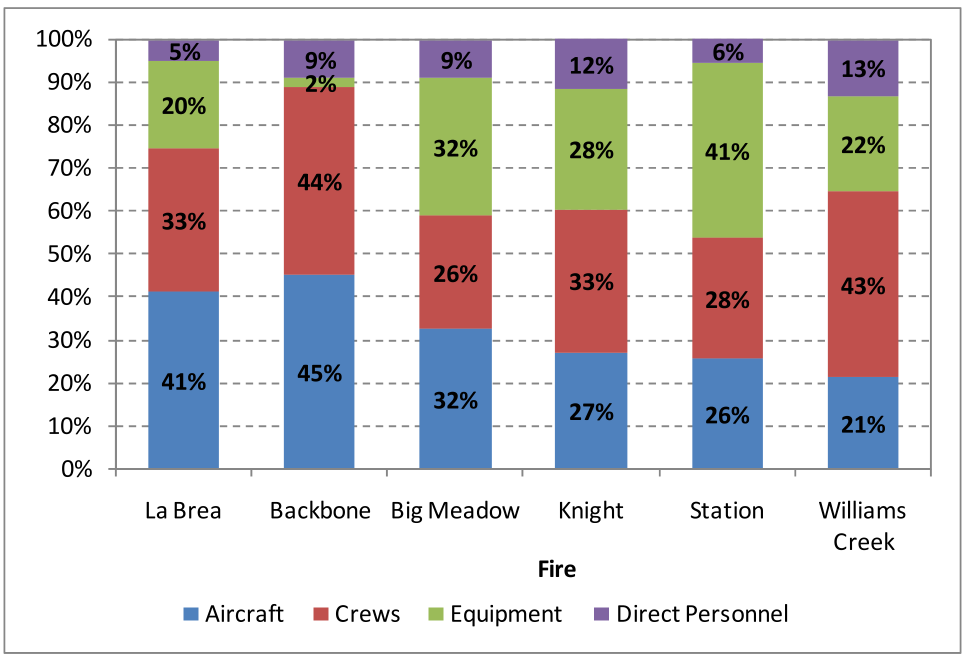
Fire	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
Williams Creek	15%	16%	31%	9%	72%	21%	8%	28%	100%
Average	**22%**	**17%**	**24%**	**6%**	**68%**	**20%**	**12%**	**32%**	**100%**

Based on the cost profile analysis, the Panel made the following observations:

Direct vs. Indirect Costs – On average, the proportion of direct to indirect costs was about the same for all fires. The overall averages for direct and indirect costs are 68% and 32%, respectively, and the individual fires are all within 3%–4% of those averages. This suggests consistency in the approach to providing support services to operations across fires, as the indirect costs represent an essentially consistent proportion of direct costs.

Direct Cost Composition – Figure 8 shows the percentage of direct costs for each major type of resource used on the six fires. This figure graphically represents the Panel's observations at the category level.

Figure 8: Direct Costs by Type of Resource



Aircraft Use – Aircraft costs averaged 22% of total costs, varying from 15%–29%. Aircraft costs, as a percentage of overall costs, were highest on the La Brea and Backbone fires, followed by the Big Meadow fire. Heavy helicopters and airtankers accounted for much of La Brea's aircraft costs. Backbone's aircraft costs also reflected the IMT's use of heavy helicopters and airtankers, but its airtanker costs were a smaller percentage of overall costs. The Backbone and La Brea fires both occurred in steep, inaccessible terrain. La Brea's aircraft costs reflected extensive use of heavy helicopters and airtankers used to drop retardant and water in support of handline construction and to construct a retardant line from which to burn out. On the Backbone fire, the IMT used aircraft primarily for moving crews and supplies to an otherwise inaccessible fire, and for supporting crews in their remote camps.

Equipment Costs – Because they had road access, the Big Meadow and Station fires relied more heavily than the other fires on equipment such as engines. Structure protection in WUI areas contributed to equipment costs comprising 32% and 41% of direct costs, respectively, on those fires. The Station fire alone spent nearly $20.9M for engines, with about 500 engines involved. The daily equipment cost chart for the Station fire shows a rapid buildup of equipment in the first seven days of the fire, and then a decrease as the IMT gradually released engines. For the Big Meadow fire there was a rapid buildup in the first five days; then it leveled off for a few days before the IMT began to release resources. In contrast the Backbone fire made little use of equipment because of the steep terrain, lack of road access, and the area's wilderness status. On the Knight fire, 28% of direct costs were related to equipment, of which 7% went to dozers used to create fireline and fire breaks.

Handcrew Costs – Two fires (Backbone and Williams Creek) with few roads had the highest proportion of direct costs related to handcrews. The fires spent about $4.8M and $4.4M, respectively, on crews. For the Williams Creek fire, Type 2 crews accounted for 76% of the handcrew costs compared to the Backbone fire where Type 1 crew costs represented 73% of the crew costs. In Oregon, where the Williams Creek fire occurred, Type 2 contract crews are common, and this accounts, at least in part, for the prevalence of Type 2 crews assigned to the fire. On the Backbone fire, given the lack of competition for resources and the steep and difficult terrain, the IMT chose to staff heavily with Type 1 crews. The Big Meadow and Station fires had the lowest proportion of handcrew costs to direct costs at 26% and 28%, respectively. Big Meadow spent $3.1M, while Station spent $17.6M.

Direct Personnel Costs – Though their overall costs were significantly higher than those of other fires, direct personnel costs as a percentage of the overall costs were lowest for the La Brea and Station fires. With the exception of the Station fire, direct personnel costs ranged from about $951K for the Knight fire to $1.3M for the La Brea fire. Because of the Station fire's size, duration, proximity to extensive WUI areas and the number of jurisdictions involved, the IMT required far more tactical resources and supervisory personnel than other fires. Consequently, the Station fire's direct personnel costs were correspondingly higher than other fires, at approximately $3.5M.

Indirect Personnel Costs –The percentage of total costs from indirect personnel was much lower for the La Brea and Williams Creek fires than the rest of the fires, at about 8%–9% compared to 13%–14% for the other fires. The Williams Creek fire spent about $1.1M on indirect personnel, compared to $3.3M on the La Brea fire. The Backbone, Big Meadow, and Knight fires spent between $1.6M and $2.4M, while the Station fire spent $13.3M.

Cost Per Acre – When analyzing and forecasting the costs of large fires, IMTs and their host agencies typically use cost per acre early in a fire to help forecast its final cost. The WFDSS uses a Stratified Cost Index (SCI) to compare the costs of large fires to historic costs for similar fires. The Backbone, Big Meadow, Knight, and Williams Creek fires had the highest cost per acre. These fires also burned the least acres (6,130 to 8,395 acres), the shortest durations (20–25 days), and had lower total costs than the La Brea and Station fires. The cost per acre tends to be lower for the largest fires, and, in the Panel's estimation, does not represent a useful reflection of either the efficiency or effectiveness of the suppression effort. We suggest a better metric in Chapter IV.

Figure 9 shows the actual cost per acre for each fire. Table 5 compares actual costs with the WFDSS- computed cost per acre used for the fires. One should note that actual costs per acre reflect costs for all participating agencies. However, the SCI reflects only Federal costs. This fact limits the utility of direct comparison, but since cost per acre comparisons and the SCI reflect the current state-of-the-art, the Panel made comparison in order to see what such a comparison might tell us.

Compared to each fire's index created by WFDSS, the fires were generally in the 50th to 75th percentile, except for Backbone which was between the 75th and 90th percentiles. This means that between 50% and 75% of all similar historical fires had a Federal cost per acre less than five of the fires. Practically speaking, with the exception of the Station and Backbone fires, the fires reviewed appear to have only been slightly more costly on a per acre basis than the median comparable historical fire.

Figure 9: Total Cost Per Acre

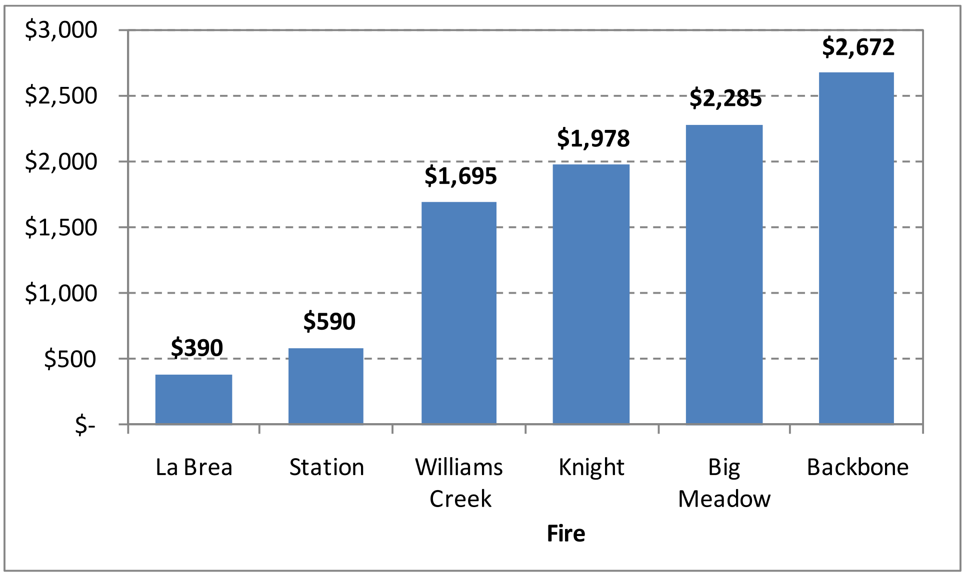


Table 5: Cost per Acre Compared to Stratified Cost Index

Fire	Backbone		Big Meadow		Knight	
Acres Burned	6,324		7,418		6,130	
Cost per Acre	$2,672		$2,285		$1,978	
WFDSS Acreage	4,000	9,000	5,000	9,000	5,000	6,500
Cost per Acre at 50th	$487	$356	$1,163	$927	$1,024	$925
Cost per Acre at 75th	$1,967	$1,439	$4,696	$3,743	$4,134	$3,736
Cost per Acre at 90th	$3,588	$2,624	$8,564	$6,827	$7,540	$6,814

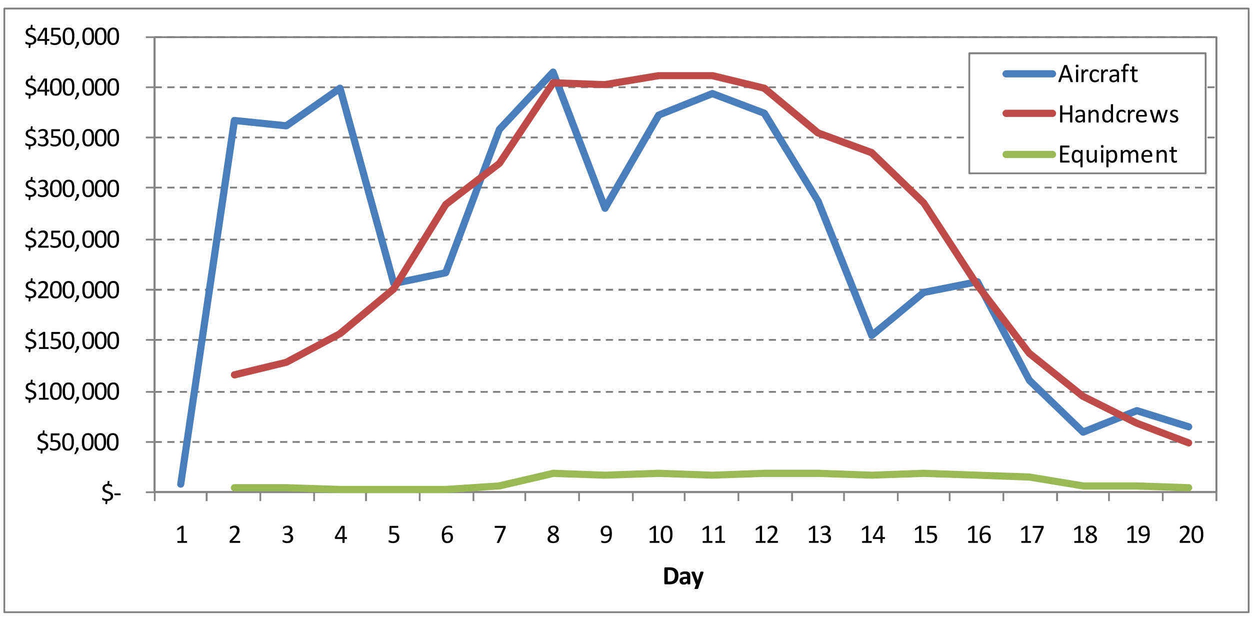
Fire	La Brea		Station		Williams Creek	
Acres Burned	89,489		160,577		8.395	
Cost per Acre	$390		$590		$1,695	
WFDSS Acreage	80,000	100,000	125,000	191,502	7,500	14,500
Cost per Acre at 50th	$321	$294	$199	$169	$1,079	$837
Cost per Acre at 75th	$1,296	$1,189	$803	$681	$4,359	$3,380
Cost per Acre at 90th	$2,363	$2,168	$1,465	$1,242	$7,950	$6,165

Daily Direct Fire Costs

On a daily basis, the use of resources varied considerably from fire to fire, but some overall patterns emerged as well. As evident from the discussion of each fire in Chapter II, the daily costs associated with aircraft, handcrews, and equipment reflected the initial attack, control, and containment strategies used for each fire.

Backbone – During the first three days, the fire suppression costs consisted primarily of expenditures for aircraft (Figure 10). After the third day, crew costs became a more important element, as the IMT moved crews on to the fire and began constructing handline. As handcrew costs peaked on the seventh day, aircraft costs also rose as the IMT used aircraft tactically as well as transport crews and supply them in their remote camps. In the end, aircraft and handcrews accounted for similar percentages of the total cost (45% for aircraft and 44% for handcrews.) The IMT spent more than a third of its direct costs (37%) on helicopters, and 32% on Type 1 handcrews. As had been noted earlier, the IMT spent very little on equipment (2%) due to the terrain, the lack of roads, and the area's wilderness status.

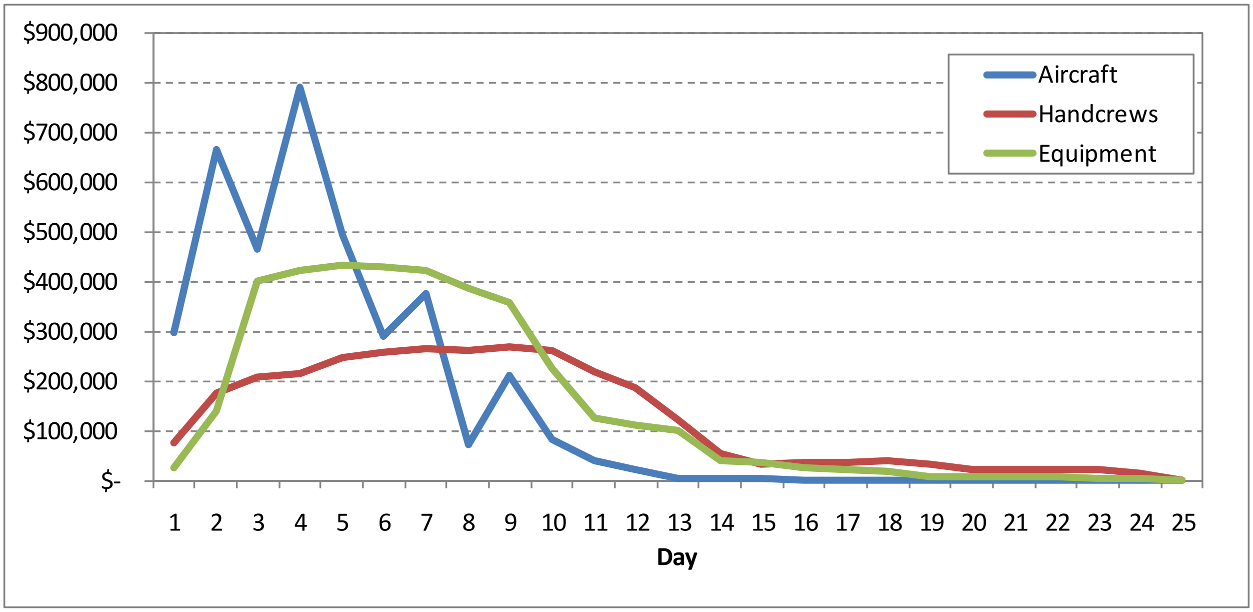
Figure 10: Backbone Daily Costs by Type of Resource



Big Meadow – During the first four days, aircraft accounted for the highest cost, but decreased fairly steadily thereafter (Figure 11). Equipment costs peaked on the fifth day and remained about the same for several days before the IMT began to release resources.

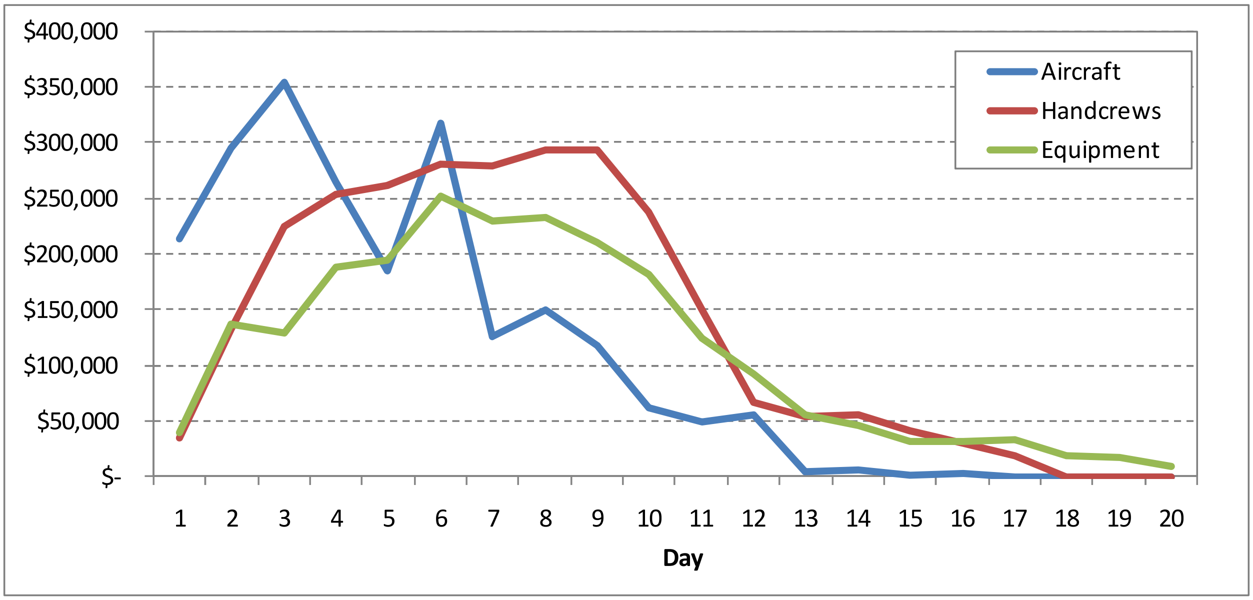
The percentage of costs for the use of aircraft (32%), crews (26%), and equipment (32%) were of roughly similar magnitude. The IMT spent about 8% of the direct costs on airtankers and18% on Type 1 handcrews. Given the need to protect structures both in and around Yosemite National Park, including those with important historic value, it was not surprising that 27% of the costs were for engines. Incident personnel were able to use engines more on this fire than others because part of the fire area was accessible by road.

Figure 11: Big Meadow Daily Costs by Type of Resource



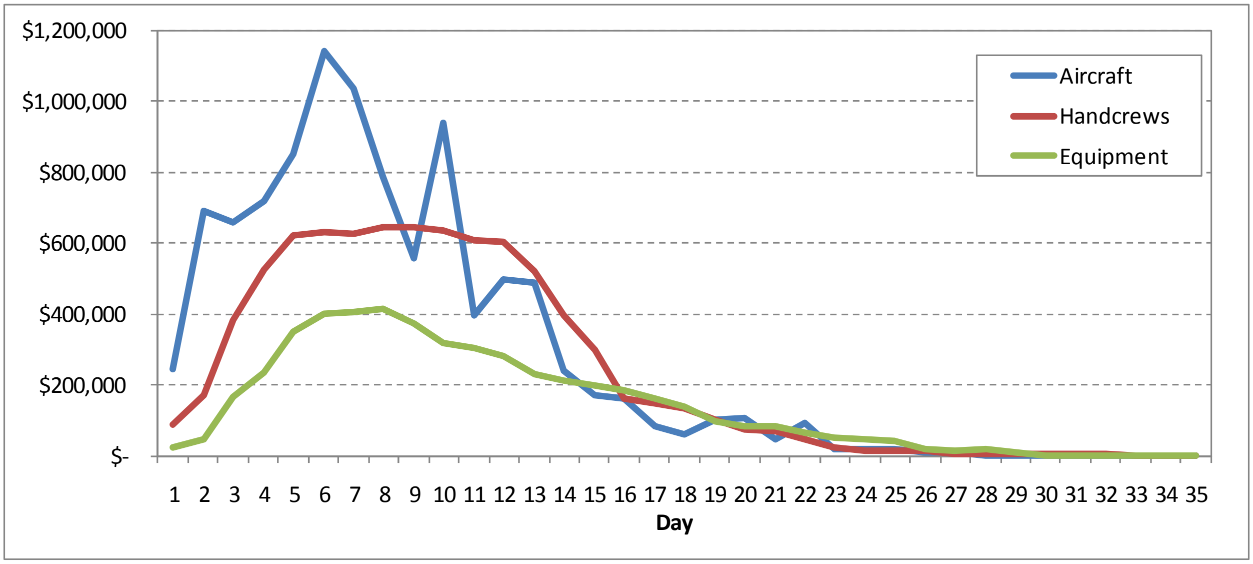
Knight – Like the other fires, aircraft costs were higher than other costs during the first few days of the fire, before crews had accessed all parts of the fire and established anchor points. Aviation costs steadily declined after the sixth day as the IMT used handcrews and equipment to contain and control the fire (Figure 12). Terrain conducive to bulldozer use and accessible roads to parts of fire allowed the use of equipment, and the IMT used engines to protect the Mount Knight community. Consequently, the fire incurred significant equipment costs. The cost of aircraft (27%), handcrews (33%), and equipment (28%) were about the same. Type 1 handcrew costs comprised 20% of the direct costs, and dozers accounted for about 7% of the costs, more for dozers than the other fires.

Figure 12: Knight Daily Costs by Type of Resource



La Brea – The daily costs for the La Brea fire (Figure 13) show that aircraft exceeded the cost of handcrews until the eighth day of the fire. The cost profile reflects a strategy of making considerable use of retardant to support handline construction and establish anchor points from which to burn. In total, aircraft accounted for 41% of costs and handcrews 33%. About 16% of the direct costs were for airtankers, and 20% for Type 1 handcrews.

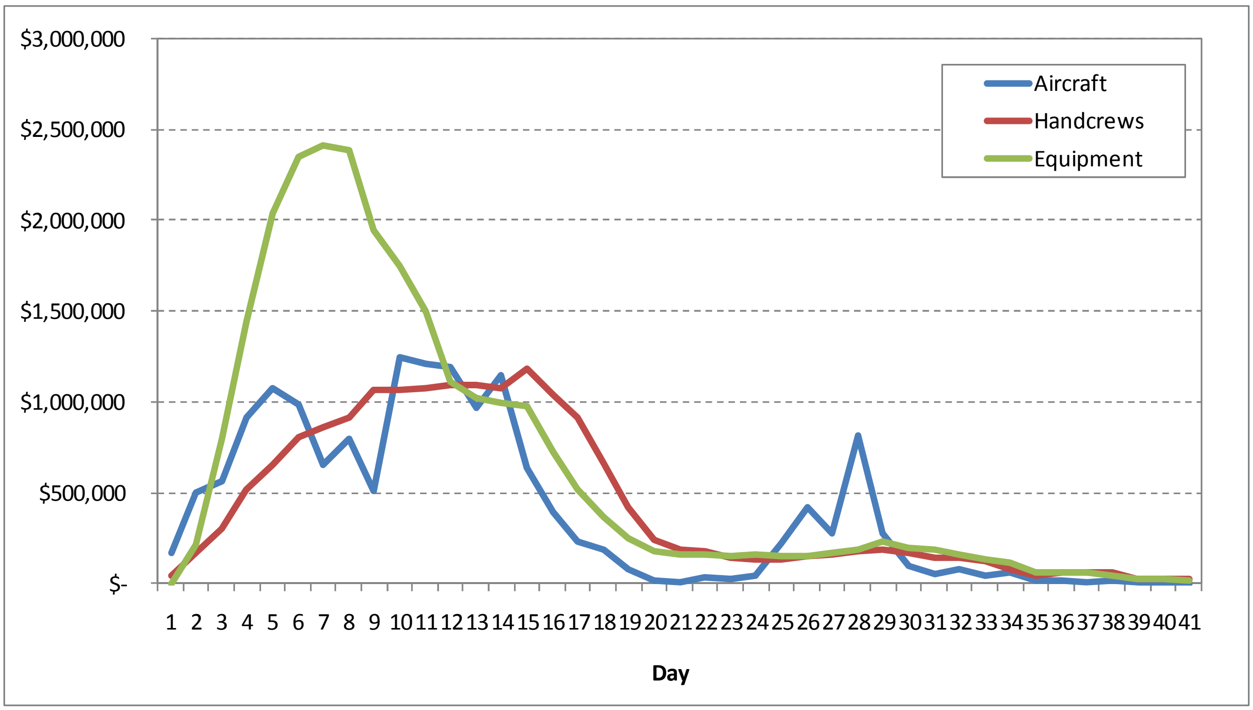
Figure 13: La Brea Daily Costs by Type of Resource



Station – In the initial stages of the Station fire, the IMT rapidly increased equipment resources for structure protection (Figure 14). After the seventh day, the IMT began releasing equipment resources at a rapid rate, and continued to do so for a week. The following week they released the remaining resources more slowly. Handcrew and aircraft use remained high during the second week of the fire.

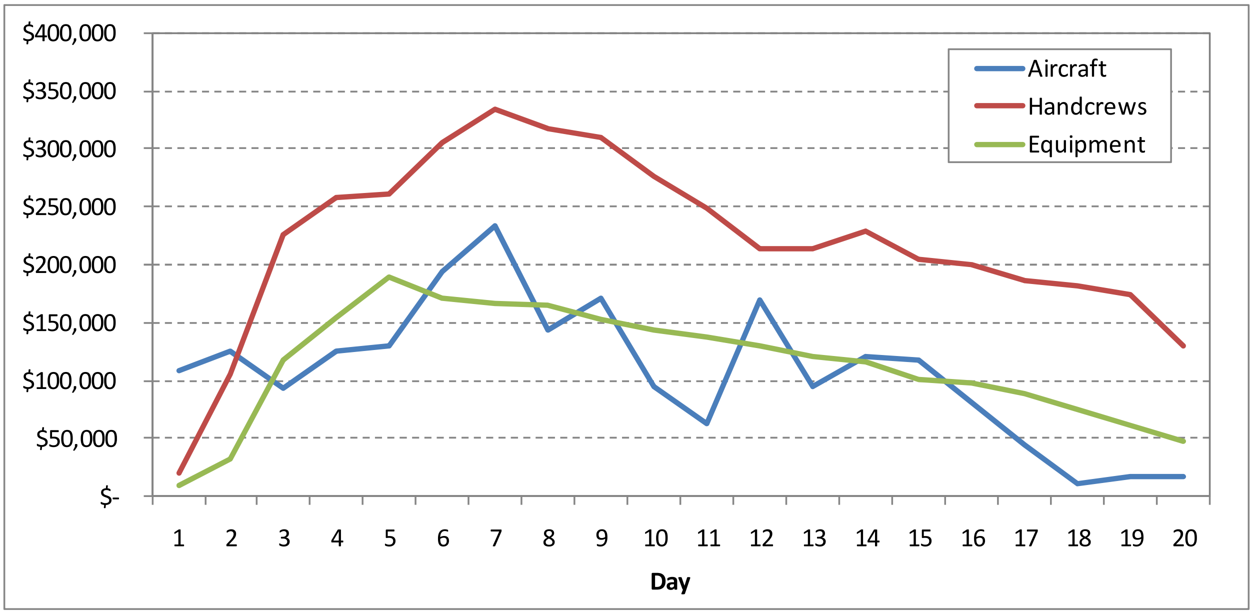
A significant difference in the cost profile of the Station fire, relative to the others, is that a second peak in aviation costs occurred between day 25 and day 29, because the IMT anticipated deteriorating fire weather conditions. Helicopters, including four heavy helitankers, began working the fire mid-morning on Saturday, September 19 and continued daily through the weekend and into the next week as needed. The IMT used these aircraft to extinguish the remaining interior hotspots and reduce the risk of embers igniting additional fuels ahead of the anticipated hot, dry and windy weather. Some hotspots were located in steep and rugged terrain, not practically or safely accessed by ground crews. For the Station fire, equipment accounted for 41% of the direct costs, supplemented nearly equally by aircraft (26%) and handcrews (28%). Engines accounted for 33% of direct costs. Both the IMT's use of aerially delivered retardant and engines reflects the large WUI exposure on this fire.

Figure 14: Station Daily Costs by Type of Resource



Williams Creek – Air resources dominated costs only for one day, handcrews thereafter. Handcrews contributed about 43% of the total direct costs, supplemented equally by aircraft (21%) and equipment (22%). The cost of Type 2 handcrews made up 33% of the direct costs. The fire burned into a largely roadless area, and threatened commercial timber lands. As previously mentioned handcrews were the primary resource supported by aircraft and equipment.

Figure 15: Williams Creek Daily Costs by Type of Resource



Comparisons with Previous Large Cost Fires

Compared to previous large fires in California and Oregon reviewed in 2007 and 2008, the percentage of costs attributed to aircraft and handcrews was slightly higher in 2009, while equipment costs were slightly lower. Table 6 shows the comparisons. In 2007 and 2008, many large fires burned: 22 in 2008 and 27 in 2007. In contrast, only six occurred in 2009. During our discussions with the staff at the Forests and the Park, all said that they had received most or all the resources they had requested. Some differences between the 2009 fires and fires in previous years may be explained by differences in competition for resources, particularly for aircraft.

Table 6: Percent of 2009 Costs for Aircraft by Region Compared to Previous Large Cost Fire Reviews

Region	2009 Fire	2009 Percent of Total Costs for Aircraft	2008 LCFR Regional Averages	2007 LCFR Regional Averages
5	La Brea	29%	**13% average** over 16 fires, from low of 3% to high of 21%	**13% average** over 6 fires, from low of 10% to high of 15%
	Backbone	29%		
	Big Meadow	23%		
	Knight	18%		
	Station	17%		
6	Williams Creek	15%	**14% average** over 3 fires, from low of 13% to high of 14%	**11% average** over 4 fires, from low of 8% to high of 15%

Table 7: Percent of 2009 Costs for Crews by Region Compared to Previous Large Cost Fire Reviews

Region	2009 Fire	2009 Percent of Total Costs for Crews	2008 LCFR Regional Averages	2007 LCFR Regional Averages
5	La Brea Backbone Big Meadow Knight Station	24% 28% 18% 22% 19%	**17% average** over 16 fires, from low of 10% to high of 25%	**19% average** over 6 fires, from low of 16% to high of 25%
6	Williams Creek	31%	**25% average** over 3 fires, from low of 21% to high of 29%	**30% average** over 4 fires, from low of 25% to high of 36%

Table 8: Percent of 2009 Costs for Equipment by Region Compared to 2008's Large Cost Fire Reviews*

Region	2009 Fire	2009 Percent of Total Costs for Equipment	2008 LCFR Regional Averages
5	La Brea Backbone Big Meadow Knight Station	14% 1% 22% 19% 27%	**23% average** over 16 fires, from low of 10% to high of 45%
6	Williams Creek	16%	**10% average** over 3 fires, from low of 7% to high of 14%

*2007 data not available

Aircraft Costs

Because aircraft represent expensive resources that can drive fire costs up rapidly and often are controversial, the Panel undertook additional analysis of aviation operations costs for the six fires reviewed.

For three of the fires (La Brea, Backbone, and Big Meadow) aircraft costs represented a substantial percentage of the direct costs of the fires. Aircraft costs for the La Brea and Station fires were $10.2M and $16M, respectively. Airtanker costs can prove especially significant. A new generation of very large airtankers (VLAT) can deliver dramatic amounts of retardant in a single load. However, as a consequence, they deliver dramatic costs as well. A single load of retardant delivered from a DC 10 VLAT costs $33,000; and a load from the experimental 747 VLAT costs $148,000.

Table 9 shows the aircraft expenditures by type and classification of aircraft for each fire. Table 10 shows the same expenditures as a percentage of total aircraft costs. Reflecting I-Suite inputting errors mentioned earlier, retardant costs on the Backbone and Williams

Creek fires, were included with costs for the type of aircraft used rather than separately identified. Additional research allowed the Panel to identify and account for these costs.

Table 9: Aircraft Expenditures by type

Category	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Retardant	-	$532,670	$368,535	$836,040	$1,570,730	$70,787
Medium Heli	$1,165,021	$180,862	$637,994	$1,166,801	$2,332,082	$25,575
Light Heli	$539,276	$126,590	$34,760	$209,375	$486,441	$166,909
Heavy Heli	$2,309,823	$1,760,676	$846,443	$3,333,432	$5,117,837	$1,367,157
Fixed Wing Air	$391,637	$282,636	$118,762	$634,801	$558,454	$422,965
Airtanker	$510,044	$940,110	$190,759	$3,983,063	$5,968,349	$106,181
Total Aircraft	**$4,915,801**	**$3,823,544**	**$2,197,253**	**$10,163,512**	**$16,033,893**	**$2,159,574**

*Note that Backbone also used retardant, but no costs were shown in the I-Suite retardant category. This was also true for Williams Creek, but the staff provided information on retardant costs that allowed the panel to adjust the numbers.

Table 10: Percent of Total Aircraft Costs

Category	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek	Average
Retardant	0%	14%	17%	8%	10%	3%	9%
Medium Heli	24%	5%	29%	11%	15%	1%	14%
Light Heli	11%	3%	2%	2%	3%	8%	5%
Heavy Heli	47%	46%	39%	33%	32%	63%	43%
Fixed Wing Air	8%	7%	5%	6%	3%	20%	8%
Airtanker	10%	25%	9%	39%	37%	5%	21%
Total Aircraft	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

* Backbone also used retardant, but no costs were shown in the I-Suite retardant category. This was also true for Williams Creek, but the staff provided information on retardant costs that allowed the panel to adjust the numbers.

Based on the six fires reviewed, the Panel concludes that there are three key operational drivers of aircraft and retardant costs: initial attack; threats to high value resources, particularly structures; and roadless, or otherwise inaccessible, areas.

- *Initial and Extended Attack* – All six fires employed aircraft on initial and extended attack. The length of time used, the type of aircraft used, and the amount of use depended on weather conditions, the terrain, access to the fire, and the aircraft available.
- *Threats to Structures, Timberlands and Other High Value Resources* – When fires threaten structures in the WUI, private commercial timber, or other high value resources; aircraft, especially airtankers and heavy helicopters, and their retardant loads are likely to represent a major cost.
- *Wilderness and Roadless Areas* – In designated wilderness areas, roadless areas, and other inaccessible terrain, aircraft costs are often high because incident personnel need to transport crews and supplies to and from the fire lines,

support firefighters in remote camps, and provide tactical support to the handcrews fighting the fire when other equipment cannot reach the fireline due to the lack of access.

The following are observations about the use of aircraft related to each fire.

- Fires near WUI (La Brea, Big Meadow, and Station) all had a high proportion of airtanker use, 39%, 25%, and 37%, respectively of all aircraft costs. The La Brea and Station fires occurred near large WUI areas, while the Big Meadow fire occurred in Yosemite National Park adjacent to a WUI area and Park infrastructure. Late in the Station fire, the IMT increased its aircraft use significantly because of anticipated fire danger.
- Fires in the less populated areas (Backbone, Knight, and Williams Creek) generally had higher proportions of costs for heavy and medium helicopters. The IMTs managing these fires used these aircraft for cargo transport as well as to deliver water and retardant. The costs of heavy helicopters ranged from 32% to 47% of all aircraft costs, except for Williams Creek, whose costs for heavy helicopters made up 63% of its total aircraft costs.
- Williams Creek also had a higher proportion of costs for fixed wing aircraft (20%), likely reflecting the IMT's use of an infrared equipped fixed-wing air attack platform.

Daily Aircraft Use – Figure 16 and Figure 17 show the daily aircraft costs, by type of aircraft, for the three fires with the highest daily costs compared to the three with the lowest daily aircraft costs.

Figure 16: Aircraft Cost by Day
(For the Three Fires with the Highest Aircraft Costs)

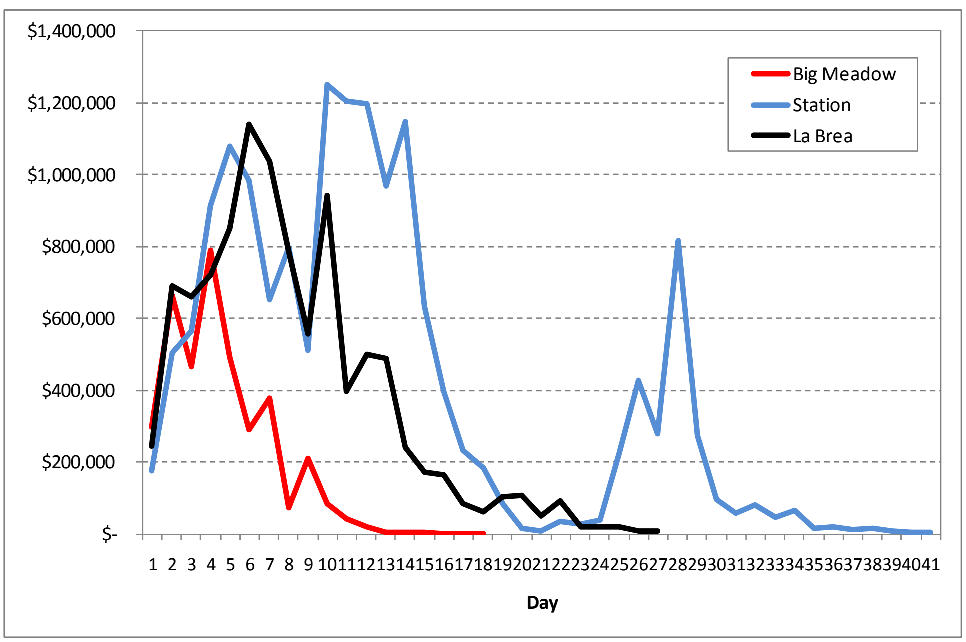
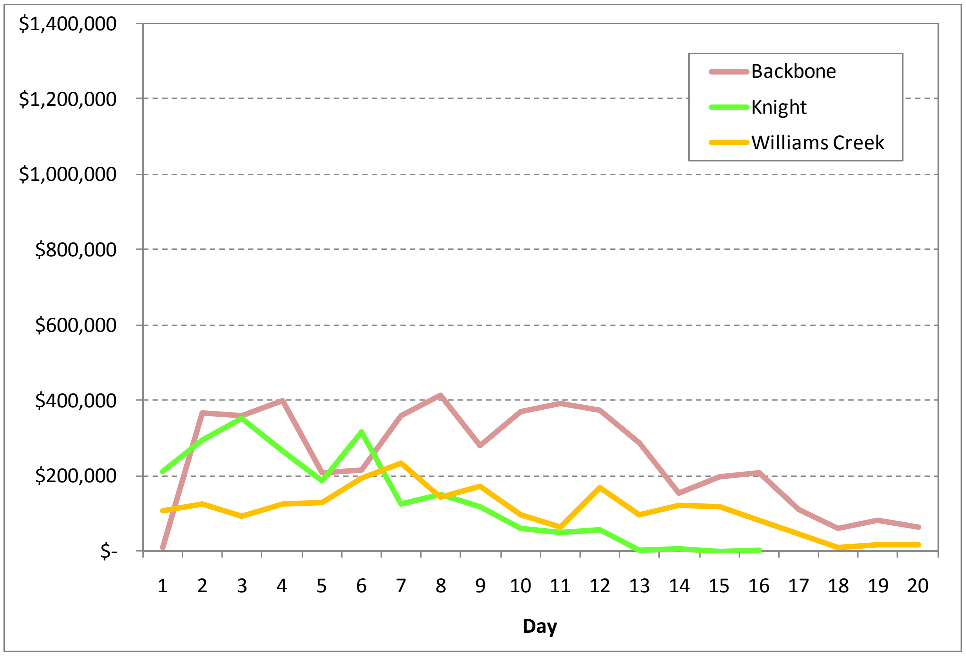


Figure 17: Total Aircraft Cost by Day
(For the Three Fires with the Lowest Daily Aircraft Costs)



Within the first few days of the six fires, aircraft use represented a significant percentage of the daily cost compared to costs for handcrews and equipment. On the first day of the six fires, aircraft costs represented 65-75% of the direct costs.

- During the first three days of the La Brea fire, incident personnel spent 53% to 73% of their daily direct costs on aircraft.
- During the first four days of the Backbone fire, incident personnel spent 65% to 70% of their daily direct costs on aircraft.
- During the first two days of the Big Meadow fire, incident personnel spent 64% to 71% of their direct costs on aircraft.
- On the first day of the Knight, incident personnel spent 72% of their daily direct costs on aircraft during the first day of the fire.
- During the first two days of the Station fire, incident personnel spent 55% to 76% of their daily direct costs on aircraft.
- On the first day of the Williams Creek fire, incident personnel spent 77% of their daily direct costs on aircraft.

Figure 18: Percent of Direct Costs for Aircraft by Day
(For the Three Fires with the Highest Daily Aircraft Costs)

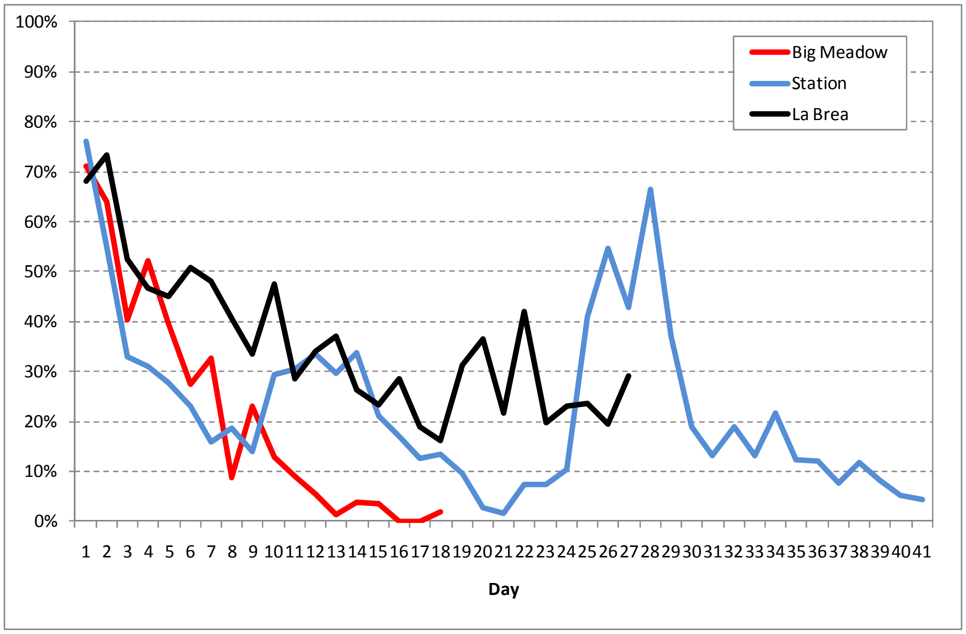
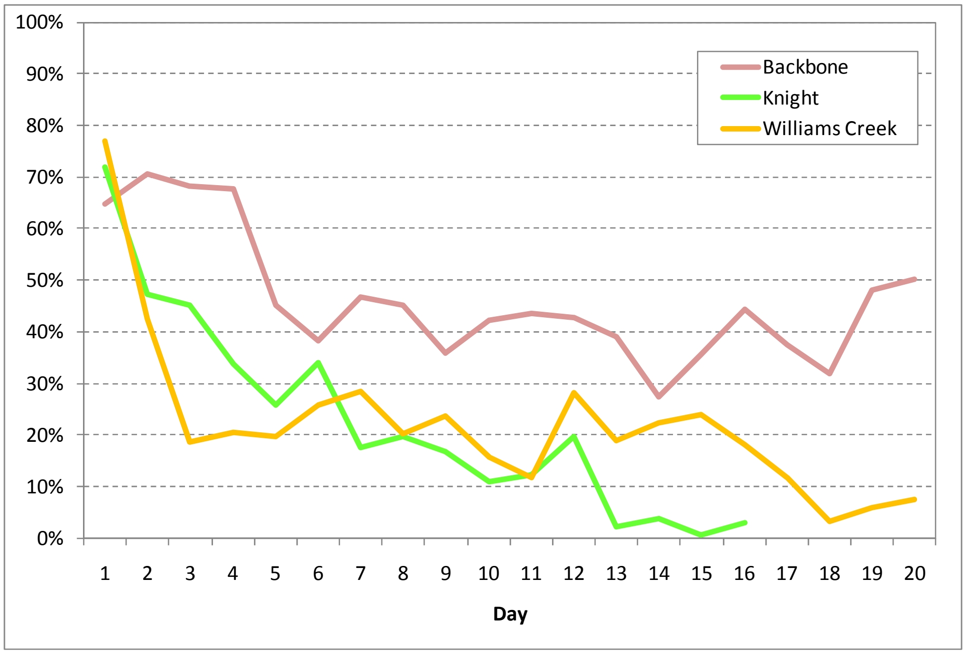


Figure 19: Percent of Direct Costs for Aircraft by Day
(For the Three Fires with the Lowest Daily Aircraft Costs)



Indirect Costs

The indirect costs on the six fires we reviewed varied from 28% to 35% of total fire costs. These indirect costs include the equipment, transportation, supplies, and daily living necessities necessary to support large numbers of firefighters as well as the people needed to set-up and run the incident command post, incident base and camps; analyze fire and weather data; feed and care for personnel; receive, manage and distribute supplies;

maintain community and media relations; and provide transportation. Table 11 shows the percentage of indirect costs for each fire as well as the indirect costs associated with every $100,000 spent on direct costs. The Backbone fire had the highest cost per $100,000 in direct costs at $55,032, while the Williams Creek fire had the lowest cost per $100,000 at $39,759.

Table 11: The Percentage and Costs of Indirect Support

Fire	Total Costs	Indirect Costs	Percentage of Indirect Costs to Total Costs	Indirect Costs per $100,000 in Direct Costs
Backbone	$16,897,750	$5,998,202	35%	$55,032
Big Meadow	$16,947,244	$5,165,027	30%	$43,837
Knight	$12,122,452	$4,016,745	33%	$49,555
La Brea	$34,888,910	$10,183,986	29%	$41,222
Station	$94,739,316	$31,947,477	34%	$50,878
Williams Creek	$14,226,245	$4,047,110	28%	$39,759
Average	**$31,636,986**	**$10,226,425**	**32%**	**$47,763**

Table 12 and Table 13 show the indirect costs, both in dollar figures and as a percentage of total indirect costs, organized by category and sub-category. Big Meadow had the highest percentage (47%) of indirect personnel costs s, and Williams Creek the lowest at 27%. The four other fires ranged between 32% and 42%. Williams Creek spent the highest percentage on catering at 18%, while the other fires spent between 12% and 14%.

- Williams Creek also spent the highest percentage on supplies at 24%, and La Brea spent the lowest at 5%. The other fires spent between 13% and 19%. The Panel believes that the high percentage of supply expenditures on Williams Creek may reflect the large proportion of Type 2 crews.
- Compared to the other fires, La Brea spent higher percentages of its indirect costs on vehicles, other support, and facilities at 10%, 11%, and 10%, respectively. Backbone also spent 12% on facilities. One possible reason is that on the La Brea fire the available camp locations were not close to the fire, and as a result incident personnel providing transportation and support traveled long distances to the fire from the Incident Command Post. The Backbone incident required extensive use of spike camps and the supplies associated with them.

Table 12: Total Indirect Costs By Cost Category

Indirect Cost Category	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Indirect Personnel	$2,262,904	$2,436,193	$1,613,523	$3,287,566	$13,260,317	$1,074,128
Kind Group Subtotal	**$2,262,904**	**$2,436,193**	**$1,613,523**	**$3,287,566**	**$13,260,317**	**$1,074,128**
Supplies	$1,039,862	$841,962	$783,023	$491,855	$4,262,446	$965,150
Showers	78,025	56,246	33,655	93,719	351,870	54,512
Rescue Medical	37,740	23,649	21,484	30,149	288,054	77,563
Other Vehicles	181,144	142,116	202,286	1,021,557	1,872,829	167,422
Other Support	189,314	292,920	172,393	1,108,508	1,535,913	312,073
Other Equipment	231,094	217,978	336,359	704,575	1,703,751	139,990

Indirect Cost Category	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Mob/Demob	95,990	136,000	132,927	4,924	1,338,989	-
Facilities	723,535	174,236	160,447	980,071	1,631,428	361,142
Caterer	722,032	679,884	459,644	1,373,747	4,341,418	723,445
Camp Crew	174,011	109,671	-	319,200	86,184	116,901
Busses	23,064	54,172	17,276	292,700	463,020	-
Kind Group Subtotal	**$3,495,811**	**$2,728,834**	**$2,319,494**	**$6,421,005**	**$17,875,902**	**$2,918,198**
Water Tenders	239,487	-	83,728	475,415	810,208	32,215
Direct Personnel	-	-	-	-	1,050	6,801
Other Equipment	-	-	-	-	-	15,768
Indirect Cost Total	**$5,998,202**	**$5,165,027**	**$4,016,745**	**$10,183,986**	**$31,947,477**	**$4,047,110**

Table 13: Percent of Total Indirect Costs By Cost Category

Indirect Cost Category	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Indirect Personnel	38%	47%	40%	32%	42%	27%
Supplies	17%	16%	19%	5%	13%	24%
Showers	1%	1%	1%	1%	1%	1%
Rescue Medical	1%	0%	1%	0%	1%	2%
Other Vehicles	3%	3%	5%	10%	6%	4%
Other Support	3%	6%	4%	11%	5%	8%
Other Equipment	4%	4%	8%	7%	5%	3%
Mob/Demob	2%	3%	3%	0%	4%	0%
Facilities	12%	3%	4%	10%	5%	9%
Caterer	12%	13%	11%	13%	14%	18%
Camp Crew	3%	2%	0%	3%	0%	3%
Busses	0%	1%	0%	3%	1%	0%
Supplies/Services	58%	53%	58%	63%	56%	72%
Water Tenders, Dir. Personnel, Other Equip.	4%	0%	2%	5%	3%	1%
Total Indirect	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Supplies – Supplies represent one of the larger indirect costs for most of the fires we reviewed, and we therefore examined it more closely. A key issue is the percent of reusable supplies that are returned to caches.

One of the larger indirect costs for most of the fires is supplies, and we therefore provide more details on that category here.

The Interagency Standards for Fire and Fire Aviation Operations define the loss/use rate as a percentage that is calculated based on the value of the items issued compared to the value of the items returned. The standards consider an anticipated fire loss/use rate for trackable and durable items issued during an incident to be 15%. Technically, the standards consider all durable items stocked in agency and interagency fire caches as returnable and accountable. The agencies maintaining fire caches typically engrave or tag trackable items with a cache identification number. Durable items are considered to have a useful life expectancy greater than one incident. The standards state that high percentages of return are expected for trackable and durable items, and acceptable lose/use percentages differ by class of items shown below:

- 10% for water handling accessories, helicopter accessories, tents, camp items such as heaters, lights lanterns, tables, and chairs,
- 20% for hose, tools, backpack pumps, sleeping bags pads, and cots
- 30% for personal protective equipment

Based on discussions with staff from both Regions 5 and 6 of the Forest Service, the return of non-expendable supplies is an area in which improvements can be made. The National Wildfire Coordinating Group initiated a pilot program in 2009 to test bar coding technology for tracking items issued during an incident. In the Forest Service's Region 6, where the agency has been participating in the supply barcode project, staff found that bar-coding proved helpful in holding persons accountable for returning items, identifying property issued to operations personnel, and containing supply costs. In Region 5 of the U.S. Forest Service, the region's analysis showed that for the five 2009 large fires in its region the fire loss/use rates were 6.4%, 25.5%, 26.7%, 26.8% and 30.4% when they excluded consumable supplies. There exists a notable disparity between loss/use ratios in the Region's North Zone, where they are low, and the South Zone, where loss/use ratios appear quite high.

Personnel Costs by Agency

All six fires employed personnel from state, local, and Federal agencies, in addition to Forest Service and NPS personnel, to fight the fires and to provide indirect support.

Table 14 shows the number of both direct and indirect personnel on the maximum staffing day (i.e. the day when the most people were working at the fire, based on the daily Incident Status Summary) and a percentage breakdown of the personnel by agency (i.e. Federal, state, local, or private/other). Observations from this analysis:

- State personnel had a significant role in providing direct fire fighting resources for fires in Forest Service Region 5 of the Forest Service except on the Backbone fire.
- The Station fire made considerably more use of local government resources compared to the other fires in Region 5 due to the fire's proximity to WUI areas protected by municipal fire departments or Los Angeles County.
- The Williams Creek fire used few state or local personnel because the additional support was provided by private contract crews as well as the DFPA acting as an agent of the Oregon Department of Forestry (ODF), which protects areas adjacent to the Umpqua National Forest.

Table 14: Percentage of Personnel by Agency on the Maximum Staffing Day

	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Total Direct Personnel	1,223	1,329	1,360	2,152	5,244	1,118
Federal	66%	63%	56%	53%	39%	44%
State	11%	28%	31%	24%	25%	3%
Local	8%	5%	1%	10%	24%	4%
Private/Other	15%	4%	12%	13%	12%	49%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

	Backbone	Big Meadow	Knight	La Brea	Station	Williams Creek
Total Indirect Personnel	263	238	172	300	580	312
Federal	67%	69%	60%	54%	53%	51%
State	5%	7%	22%	22%	17%	12%
Local	20%	21%	8%	22%	27%	3%
Private/Other	8%	3%	10%	2%	3%	34%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Federal Resource Costs in California

There are large differences in what a Federal engine or crew costs in one part of the nation from another. These variations need to be considered when trying to understand why costs of some fires of a given size are so much more than others. Federal resources cost more (often substantially more) in California than elsewhere due to locality pay, grade differentials between regions, the special pay rate for firefighters in Southern California, and differences in staffing configurations. When combined, higher Federal costs coupled with higher costs for cooperator resources (agreement costs), as discussed below, contribute substantially to the higher cost of fighting fire in California when compared to fire costs elsewhere.

Local and State Government Costs in California

The Federal agencies call expenditures they paid for Federal use of resources owned by local and state cooperators "Agreement Costs." An examination of four of the six fires reviewed showed that costs paid to cooperators by the Forest Service represented a significant percentage (21-32%) of the total costs incurred by the Forest Service, as shown in Table 15.

State and Local Unit Costs – Costs paid for state and local crews, engines, and single resource personnel typically are much higher in California than elsewhere. The agencies establish billing rates as part of comprehensive cooperative agreements. Information from the Forest Service's financial system shows that their Pacific Southwest Region had, by far, the highest agreement costs for all fires over $1M nationally.

Forest Service Region 5 staff indicated that state costs for resources typically are 1.5 to 2 times Federal costs for similar resources, while local government costs are 2–3 times the Federal costs for similar resources. For example, Los Angeles County bills their Battalion Chiefs at $160.48 per hour, while a similar Forest Service Battalion Chief (at GS-9, Step 6) would cost the government $65 per hour.

On the other hand, when a Federal agency obtains the services of local or state government personnel, they benefit from skilled and experienced firefighters for whom they did not have to hire, train, or provide a position. Nor did they have to pay, or provide benefits to them outside the period of the incident.

In the Forest Service's Region 5 there have been efforts to renegotiate agreements. A February 2010 memo indicated that Region 5 was taking steps to limit administrative charges to ten percent; not allow costs for retirement, health, life, and other benefits that are already covered by the jurisdiction's budget; and eliminate reimbursement for support personnel on a portal to portal basis and pay only for actual hours worked.

During the Panel's review, the Forest Service's Region 5 staff was continuing the process of renegotiating agreements with local government cooperators. However, non-Federal cooperators might only have limited discretion to change certain agreement costs because of labor agreements with their firefighters.

For example, in the Forest Service's Region 6 an agreement with one fire district has already eliminated portal to portal pay and states the following: "Reimbursable costs shall not include portal to portal pay or the employee portion of benefits". In addition, the agreement also states that the "base hourly rate shall be no more than step 5 of the appropriate GS wage adjusted for locality pay at the location of the fire district." There are different cost factors in each region, and cost share agreements will reflect regional differences where appropriate.

The costs paid to cooperators by the Forest Service after cost share agreements were struck, still represented a significant percentage (21%–32%) of the total costs incurred by the Forest Service, as shown in Table 15 and Table 16.

Table 15: Agreement Costs Compared to the Total Forest Service Costs

Fire	Forest Service Cost	Agreement Costs (within the Forest Service Cost)	% of Cost
Backbone	$15,963,096	$1,532,063	10%
Knight	$11,243,953	$2,634,301	23%
La Brea	$32,831,026	$6,968,868	21%
Station	$85,593,319	$27,516,658	32%
Williams Creek	$14,226,2252	$192,288	1%

Table 16: 2009 Agreement Costs Compared to Total Forest Service Costs for Fires Greater than $1M

Region	2009 Total Costs	Agreement Costs	Agreement Cost Percentage
1	$9,772,394	$87,648	1%
2	$1,196,708	$357	0%
3	$25,189,466	$2,658,500	11%
4	$13,771,523	$1,176,893	9%
5	$257,560,038	$59,998,405	23%
6	$88,290,687	$3,372,282	4%
8	$6,550,137	$279,611	4%
9	$1,521,003	$27,767	2%
Total	**$403,851,956**	**$67,601,463**	**17%**

Cost Sharing

During an incident, a cost sharing team determines how participating agencies will ultimately share the costs of fighting the fire. Cost share agreements can take a number of forms. In some cases, participating agencies pay for what they order, essentially agreeing to cover the costs of specific resources used in support of their specific mission. Many other forms of cost share agreements exist, such as sharing costs based on acres burned in each DPA.

Shared costs may or may not appear in the I-Suite database, depending on whether the IMT controlled the resources generating the costs. Similarly, shared costs may, or may not, appear in the agency accounting system, depending on which agency made the initial payment. For example, Forest Service personnel suggested the official total cost of the Station fire does not include several million dollars in costs paid directly by cooperators.

The Panel reviewed the cost share information for four of the six fires reviewed. For those fires, cost figures from the U.S. Forest Service's financial system show that the U.S. Forest Service paid between 90% and 94% of the total incident costs represented in I-Suite. Incident Business Advisors

Incident Business Advisors

The Interagency Standards for Fire and Aviation Operations require the use of an IBA for each large fire. According to the Standards, "An IBA 1 must be assigned to any fire with suppression costs of more than $5M, and an IBA 2 is advised for fires with costs of $1M–$5M. If a certified IBA is not available, the approving official is to appoint a financial advisor to monitor expenditures. Incident suppression cost objectives will be included as a performance measure in Incident Management Team evaluations."

Based on discussions with the various forest staffs, the Panel made the following observations about IBAs:

- IBAs receive a separate DOA from the agency administrator.
- IBAs act as a liaison between the agency administrator and the IMT as well as overseeing and monitoring costs.
- IBAs are in short supply, and not every agency unit has access qualified IBAs or personnel who have the desire to be an IBA. In one region there was a 50% chance that the position would be filled in 2008, and in 2009 there was only a 30% chance. This is especially true in the Forest Service since they have centralized their financial functions in the Albuquerque Service Center, leaving few finance staff available in the regions and on the Forests.
- IBAs with local knowledge about the area are preferred and can be especially useful to assist an IMT from out of the area.

Overall, the personnel interviewed believed that IBAs were helpful and assisted in managing the costs of their fire.

CHAPTER IV. MAJOR FINDINGS AND RECOMMENDATIONS

This chapter presents the overall findings of the study in light of the four main tasks given to the Panel: evaluating fire costs in light of risk management and finding ways to further mitigate large fire costs; examining tools, technology, and guidance; and suggesting improvement to the cost review process. We discuss technology, tools and guidance; metrics, and the cost review process at the end of this chapter, after first discussing findings and recommendations dealing with costs.

Key Findings

Prudent Decisions – The Panel found that overall, agency administrators and incident personnel made prudent decisions on each of these six fires in light of the risks and circumstances they faced. Hindsight always finds things that might have been done better. Indeed, involved personnel learned many lessons, and we make related recommendations for improvement. However, on every fire we found that agency personnel paid attention to risk management and cost control.

All things considered, the Forest Service and NPS should take pride in how well their personnel performed under pressure when handling the complex situations they faced on the six large wildland fires we reviewed. The agencies could have reduced some costs on some fires. However, without prudent decisions and consideration for costs and safety, the fire costs would, in all likelihood, have been much higher, exposure to risk greater, , and property losses worse

Cost Management – Both agency administrators and incident commanders proved very conscious of costs, and took steps whenever possible to limit or reduce costs given the firefighting conditions and strategies chosen to contain the fires. Built-in checks and balances largely worked. For example, agency administrators and their representatives examined the decisions of ICs, GACC personnel reviewed resource orders, cost unit leaders and IBAs tracked and reviewed spending, etc. It was obvious to us that cost containment strategies were considered and practiced at all levels.

Direct costs were largely a function of the duration of the fire, number and mix of aircraft, the number and type of handcrews, and the types of equipment used. The firefighting conditions that existed on each fire influenced these costs significantly, and those conditions are principally related to fuels, weather, topography, resource availability and accessibility. Indirect costs included overhead and support personnel, supplies, catering, travel costs and other factors that are largely proportional to the number of personnel fighting the fires. Although the mix of direct costs differed among the fires, the proportion of indirect costs to direct costs was very similar for all six fires. This consistency suggests the support system operated similarly across fires and as planned.

Savings vs. Costs – The agency administrators and IMTs, state and local cooperators, and the thousands of firefighters involved in the firefighting, together saved tens of thousands of acres of wildland resources, large numbers of homes, valuable commercial timber, watersheds, and much infrastructure such as communications antennas and transmission lines. One problem associated with past reports on large cost fires, is the lack of adequate metrics to compare value saved with the fire suppression costs. We have suggested an approach to measuring values saved, enabling Federal fire agencies to better evaluate the cost-effectiveness of wildland fire suppression. (Metrics are discussed in a section below.)

Control of Cost Factors – An important finding of the review Panel is that many factors affecting fire suppression costs are largely outside the control of ICs and others managing the fires, and are due to combinations of a changing operating environment, social and political expectations, and other forces. Some influences that take cost control out of the hands of agency personnel prove particularly acute in California. Some important cost factors are discussed below.

Wildland Environment – As is well known, wildland fires are getting more frequent, larger, and more intense as a result of climate change, drought, declining forest health, and accumulated wildland fuels. Trends clearly indicate that the cost of wildland firefighting will continue to rise, with some annual variation. However, the majority of those costs appear to be justified within a context of growing complexity.

Initial Attack – Although we recognize that there exists some controversy regarding initial response to both the Station and Big Meadow fires, we generally found the initial attack on all the fires reviewed to be appropriate to the situation, given the information available to us. Humans started some of the large cost fires, while lightning caused others. Each fire started on steep slopes, and several were in designated wilderness. All of the fires originated in locations that firefighters found difficult to access. The Big Meadow fire was the result of an escaped prescribed fire in Yosemite National Park. Each high cost fire escaped despite rapid discovery and what local fire managers usually consider adequate resources for initial attack. In all cases initial attack resources could not stop the fires because they were in difficult terrain, were largely inaccessible, and because the fuel and weather conditions promoted rapid fire spread and extreme fire behavior. In most cases, personnel recognized that these fires would become very large on the first day or two after they escaped initial attack. In some situations this conclusion was reached within hours of assessing the fire (e.g., Knight and Williams Creek).

Wildland-Urban Interface/ Intermix and Built Infrastructure – People continue to build homes and other structures in fire-prone environments, despite greater public awareness of the dangers posed by wildland fire and the need for defensible space, and broader involvement of communities in mitigation efforts. (2009 Quadrennial Fire Review). The protection of communities and community infrastructure significantly increased fire suppression costs on five of the six wildfires we reviewed. Agency administrators and incident commanders consistently stated that the need to protect homes and high value community infrastructure in the WUI limited their flexibility in decision-making and led to higher cost strategies. In some cases, even small numbers of homes threatened by the fire significantly affected strategies and incurred costs for heavy use of aircraft, the deployment of structure protection engines, and evacuations.

Hazard Mitigation at the Landscape Level – On three of the fires (Station, La Brea, and Big Meadow) fuel reduction/mitigation treatments prior to the fires played a significant role in the successful protection of homes and high value infrastructure. IMTs were able to develop tactics around existing fuel breaks, which ultimately led to reduced fire suppression costs. On the other hand, in several cases, fire officials stated that the lack of pre-fire fuel treatments greatly increased the costs of protecting certain high value infrastructure (e.g., the communication sites on Mt. Wilson during the Station fire).

Constraints on Vegetation Management – Forest Service efforts to modify fuels in an attempt to create conditions that would slow or stop an advancing wildfire or moderate fire behavior, were often limited by outside influences over which the agency has little control. For example, on the Angeles National Forest, prescribed burning projects are limited to less than 100 acres because of air quality regulations. Also, because of administrative appeals, litigation, and market conditions, timber and fuels management projects are often difficult and time consuming to implement.

High Value Natural and Cultural Resources – Besides homes and other human-made infrastructure that were at risk from the large fires, fires also threatened high value natural and cultural resources as well. These included watersheds important for urban needs, critical wildlife habitat, designated threatened and endangered species habitat, commercial timberlands, anadromous fish streams, and sites of cultural and historic importance to Native American tribes. Consideration for these resources clearly affected strategic choices and always resulted in higher fire suppression costs.

Land/Resource Management Plans and Fire Management Plans – Management direction in LRMP and FMP in the areas of the six fires rarely incorporated specific risk or cost management considerations. This shortcoming affected wildfire suppression costs in that they did not adequately inform decisions that drove the fire suppression strategy from a cost standpoint. As a result, decisions in these plans inadvertently may have driven suppression costs higher. For example, Forest Service personnel on the Stanislaus National Forest stated that decisions in the LRMP to limit road systems to the minimum necessary for the protection of certain natural resources can slow the initial fire response and force a reliance on aviation resources, which in turn can increase suppression costs.

Incident Management Teams – A variety of IMTs, in a variety of combinations, managed the six fires reviewed; sometimes in uncommon combinations and sometimes making an expedited transition to local Type 3 IMTs. On some fires, more than one level of team worked together on the incident at the same time (e.g., a NIMO team and an IMT-1), with mixed results.

Agency Administrators' Role – Agency administrator (line officer) engagement in fire management seems to be improving both in quantity and quality. The agency administrators responsible for the six fires reviewed were fully engaged in the decision-making. Overall, agency administrator involvement was healthy in controlling costs and assuring sensible risk management. They were, for the most part, consistently involved and provided oversight to the IMT. Positive, effective working relationships between agency administrator and IMTs proved critical to success on several of the fires. When this relationship is less than effective (La Brea), or lines of authority are confused (as was the case on Big Meadow), decision-making slows down with direct implications for efficiency and cost. Ironically, on some fires, agency administrators and their representatives may have been too involved, with multiple senior people on the scene, giving conflicting direction to the IMT. Lack of clear intent, tentative decision-making, and failures to nurture effective relationships with ICs and their teams, on the part of agency administrators, can have both direct and indirect cost implications, including the overuse of costly resources such as airtankers and heavy helicopters.

National Incident Management Organization Teams – Agency administrators used NIMO teams on three of the six fires we reviewed, each in a different way, with mixed results. The Panel believes that NIMO teams have the potential to help reduce incident costs by bringing significant decision support skills and experience as well as the ability to mentor other IMT and unit personnel but the Forest Service needs to clarify their role.

Incident Business Advisors – On each fire where IBA were available, the Agency Administrators and ICs felt the IBAs were an asset to them during the fire. They helped track costs, identify potential costs, find contracts, and sometimes provided advice on cost saving alternatives and policy. While it was difficult for us to determine whether the IBAs saved much money, agency and incident personnel wanted them and they proved to be in shorter supply than desired.

Delegations of Authority – Judging from the fires we reviewed, letters of DOA to IMTs rarely contain specific cost-containment direction. For five of the six fires reviewed, the agency administrator used some variation of a general statement in the DOA, such as: "Manage the fire in a cost-effective manner commensurate with values at risk, and provide for firefighter and public safety." While we believe that delegation letters should specifically identify cost containment goals when appropriate, according to one IC interviewed, DOAs also are becoming long, complicated, contradictory, and difficult to understand in the first hours of a fast-moving fire. We believe more attention needs to be paid to the specific goals for containing costs on each fire.

Direct Protection Area Boundaries – The Federal agencies and the states agree upon and delineate DPAs in which each assumes the responsibility of maintaining a wildland fire protection system. Federal agency DPA boundaries often fall along land ownership and political boundaries rather than along defensible topographic features. As a result, Federal agencies often find themselves faced with trying to stop wildfires at very difficult locations, such as mid-slope.

To address this situation the Forest Service has agreed to protect state or private lands adjacent to National Forests in order to create sensible DPA boundaries. For example, on the Angeles and the Los Padres National Forests this means that the Forest Service DPA includes lands designated as either State Responsibility Area or Local Responsibility Area. Such an arrangement, while making sense politically, or even operationally, can add significantly to Forest Service fire suppression costs by making the protection of structures and associated infrastructure a Forest Service responsibility. Complications associated with DPA boundaries played a role in both the Station and La Brea fires.

Firefighter Safety – The wildland fire agencies have engendered a remarkable culture change over the past fifteen years, by putting greater emphasis on firefighter safety. What the agencies have not made clear to the Congress is that in that time, addressing firefighter safety concerns has also, necessarily, increased the costs of providing fire suppression. Firefighter safety mitigations on individual fires also bear costs, and firefighter safety concerns affected strategy and likely affected fire costs on every fire reviewed. Most of the six fires we studied started in locations and under conditions in which direct attack would have been extremely dangerous. Fire locations and conditions necessitated indirect attack, enlarged fire perimeters, and increased the length of firelines, all of which increased the amount of labor required and resulting costs.

Cost of State and Local Fire Agency Resources – Formal agreements govern the relationships between Federal, state and local government agencies. A Cooperative Agreement (sometimes called the "Master Agreement") between the Federal agencies and the State governs all aspects of fire business management between cooperating partners, including interagency billing procedures; individual, local agreements; and cost sharing agreements. In California, the California Master Cooperative Wildland Fire Management and Stafford Act Response Agreement, commonly referred to as the CFAA, serves this purpose.

In California, interagency IMTs increasingly depend on state and local agency personnel for staffing. Up to 60% of the personnel on interagency IMTs in California come from state and local government agencies, which increases the cost of IMTs because state and local fire personnel in California often receive higher salaries as well as more costly benefit and overtime provisions. Many are paid portal-to-portal (24 hours per day) while on fire assignments, as required by agreements between their unions and their employers. Arrangements such as added administrative fees and minimum commitment periods also increase the costs of these personnel. Local and state engines and other equipment can also cost more than comparable Federal agency resources for reasons similar to those mentioned for IMT personnel. The same is true for some handcrews.

However, Federal agencies depend extensively on state and local agency personnel for a number of reasons, most notably because, agency workforces have become more specialized, and because over time, the Forest Service reduced its non-fire workforce , and the agency struggles to maintain the historical level of involvement in the fire program by collateral duty personnel. In addition, Federal agencies often require local interagency response to achieve rapid initial attack on wildland fires, to staff multiple simultaneous fires that at times can strain Federal resources, and to adequately protect structures in the WUI.

IMTs request a wide variety of resources through a network of dispatch and coordination centers, but once orders are placed, incident management personnel have little control over which particular resources will actually fill their order. In addition to cost, GACCs must consider many factors such as availability, work/ rest guidelines, requirements from other fires, balancing workloads, providing experience, and fairness in assignments when filling orders. Consequently, IMTs and receiving agencies exercise little control over the actual costs of responding resources.

National Mobile Food Services Contract – Although the concept of negotiating national contracts for certain key suppression resources and support services is sensible and cost-effective from a national standpoint, it can restrict local flexibility in contracting for certain support services, such as food service. Local fire officials and IMT personnel on several fires in California stated that they could have saved money by providing meals to firefighters using less expensive CAL FIRE mobile kitchen units when they transitioned to Type 3 organization. Unfortunately, the Panel did not have the opportunity to verify the potential savings referenced.

Mop Up Operations/Maintaining Fire Control – On virtually every fire reviewed, the ICs seemed conscious of the costs of retaining large numbers of resources on-site after their fire reached containment. They tried to demobilize as fast as they thought was safe and prudent. However, in the process of ramping down, incident commanders frequently hold some resources. While, on paper, this might at first seem like demobilization that was slower than desirable, and a waste of resources, the IMT must complete mop-up operations (final extinguishment of pockets of fire) and maintain a reserve force in case weather changed and the fire flared up or jumped a line. Another reason for holding resources was that the GACC may elect to stage resources at an existing fire as a base from which to attack emerging fires, rather than duplicating mobilization costs and mobilization time.

Aviation Operations – On all the fires we reviewed, incident commanders employed large scale aerial attack early, to slow the fire's growth with retardant and water. ICs employed retardant variously in conjunction with ground forces, while ground forces were being assembled, and in areas where they believed direct ground attack was not safe. IMTs also used helicopters on some of the fires to transport crews and equipment to inaccessible areas, as well as to drop water or retardant to support fireline construction by ground crews. Costs of aviation resources accounted for 14%–29% of total fire costs on average.

Based on information made available to us and the statements of involved personnel that we interviewed, the Panel found the effectiveness of some aerially delivered retardant questionable on four of the six fires reviewed. Ironically, a perceived lack of retardant use early in the fire lies at the heart of controversy swirling about the extended attack on the Station fire.

Very Large Airtankers – A new wildfire fighting tool used in 2009 on the Station fire was the VLAT. These aircraft included a DC-10 and a Boeing 747, both specially configured for dropping fire retardant. These VLAT carry a much larger payload of retardant than conventional airtankers, but are not as maneuverable in steep terrain, and are much more expensive to operate. Their functionality, effectiveness and efficiency remain to be proven, though incident management personnel thought the DC-10s were cost effective on the Station fire.

Political and Social Pressures for Retardant Use – Airtankers and heavy helicopters have become the most visible sign of wildland fire suppression operations over the past 20 years. Images of airtankers dropping retardant on the front page of newspapers, on the nightly TV news, and on YouTube, have led many in the public, the media, and the political arena to believe that these drops are the most important, if not critical, tool for suppressing wildfires. When fire managers do not use these resources, many people believe that firefighting agencies are not using all available resources to save structures and natural resources. Because of the publicity surrounding the new VLATs, the Forest Service has felt public and political pressure to use them on wildfires, especially in California, even when their effectiveness may be limited.

Wildland fire agencies know that while retardant and heavy helicopters can be effective tools, they can also be inappropriate, particularly since they represent expensive tactical tools. In addition, as wildland firefighter fatality records show, flying firefighting aircraft represents a dangerous business. From 1990–2009 aircraft accidents represented the leading cause of wildland firefighter fatalities. In just three years (2007–2009), 21 fatalities occurred. They occurred in both fixed wing and rotary wing aircraft, from single engine airtankers and large multi-engine airtanker to all types of helicopters.

Cost Sharing – The participating agencies established effective cost share agreements for the Knight, La Brea, Station, and Williams Creek fires, in accordance with the appropriate master agreements. In each case, the responsible parties appear to have adequately tried to assure that the cooperating agencies shared fire costs commensurate with their jurisdiction and responsibilities. Given the diligence apparent in these documents, the Panel believes that neither the Forest Service nor NPS paid significant costs that they should not have.

Tools and Technology – Incident management teams, agency administrators, and their staffs made greater use of computer models and decision tools than ever before, judging by our review of the 2009 large cost fires. Incident management teams also used airborne infrared equipment, and made use of computer technology in the field. Generally the decision makers on each of the six fires gave the new tools good marks, and said they helped in decision making, and in documenting and communicating risk management and cost management decisions. We give more details on findings and recommendations regarding tools and technology in a section below, reflecting the topic's status as one of the three major tasks assigned to the Panel.

Revising the Review Process – While the cost review process has been of value, it includes redundant efforts and findings are not reaching the people who make important decisions affecting fire costs. As with tools and technology, we offer more detailed findings and recommendations in a section below, as recommendations for improving the review process also represents one of the three major tasks assigned to the Panel.

Recommendations

There exist several ways to significantly reduce the cost of large fires such as the six 2009 fires reviewed. Incident managers also have at their disposal myriad ways to achieve smaller cost savings that will not materially affect the magnitude of the expenses. We focused on recommendations that can have significant affect: While previous review panels have proposed similar recommendations as ours before, we found that the agencies have not yet fulfilled them, and those ideas still have merit.

1. Mitigation for the Wildland-Urban Interface and Built Infrastructure

Recommendation: Create more effective alliances and relationships with WUI communities to reduce the exposure of homes, businesses, and associated built infrastructure (e.g., power lines, communication, and other high value resources).

As described in the Forest Service's 2009 Quadrennial Fire Review, Federal agencies must create and nurture more effective alliances and relationships with communities in and around their jurisdictional boundaries. These relationships and alliances include those with state and local government, builders and developers, home and business owners, and the insurance industry. The goal should be to achieve "fire adapted communities" through a combination of public education, creation of defensible space, building and subdivision codes and ordinances, and land use planning in wildfire-prone areas.

2. Agency Administrator Role and Direction

> **Recommendation:** Ensure a clear line of authority and communication between agency administrators and the IMT, especially when multiple agencies or agency units are involved. If NIMO teams are used make sure they have a clear role coordinated with the role of other assigned IMTs. Make sure that delegations of authority and letters of intent provide clear direction, including specific cost related guidance such as limiting airtanker use or specialty resources, as appropriate

The agency administrator must achieve unambiguous authority relationships, establish clear intent, prove visible and available, and make plenty of time available for direct interaction with the IC/IMT. The Williams Creek and Backbone fires provided particularly good examples where unity of purpose and a clears line of authority and communication were quickly achieved in complex situations.

3. Incident Business Advisors

> **Recommendation:** Conduct an IBA needs analysis, develop an IBA recruitment strategy, and then recruit and train more IBAs, especially in areas where larger fires are common.

IBAs are required by Interagency Standards for Fire and Aviation Operations. All things considered, they represented a useful asset but are in critically short supply.

4. Direct Protection Area Boundaries

> **Recommendation:** Where necessary, realign DPA boundaries to assure they better coincide with defensible topographic features rather than political or ownership boundaries.

When Federal ownership boundaries lie on terrain that is difficult to defend, such as mid-slope, the agencies should work with adjoining state or local jurisdictions to define more logical and defensible DPA boundaries. One way to do this is for the Federal agencies to move their DPA boundaries down-slope to flatter, more defensible ground on lands that are currently the responsibility of state or local government. Another alternative is to move the DPA boundary to a defensible topographic feature within Federal ownership (such as to a ridge line) and assign the protection responsibility for lands excluded to the state or local fire protection organization. A third alternative is for the Federal agency to contract the protection of Federal lands adjacent to the WUI to either the state or the local fire service, and align the boundaries of the contract area with defensible topographic features. These alternatives are consistent with the 2009 QFR premise that the protection of wildlands surrounding or adjacent to the WUI should be provided by the protection organization that is best-suited and positioned to effectively and cost-efficiently provide that protection.

Realigning DPA boundaries may, in some cases, necessitate having state or local government agencies protect some Federal lands. Where necessary, realign DPA boundaries to assure that wildlands surrounding or adjacent to the WUI are protected by the organization best suited to provide protection cost-effectively.

In our opinion, it may be more cost effective to have state or local government protecting some Federal lands rather than for a Federal agency to protect state or private lands. Under this circumstance, local or state agencies protecting Federal lands should also exercise considerable influence over land management decisions and have the ability to implement appropriate fuels treatments.

5. **Hazard Mitigation at the Landscape Level**

Recommendation: Focus fuel reduction efforts both on Federal and non-Federal lands into the areas with high value resources at risk, such as the WUI, with an emphasis on creating community defensible space and fuel hazard reduction zones. Properly space, sequence, and maintain fuel treatments to meet these aims.

This is consistent with the 2009 QFR. Such projects have the potential to slow the advance of a wildfire and to moderate its behavior. Treatment areas also provide opportunity for suppression anchor points and can reduce the amount of line construction necessary, thereby reducing costs. This situation occurred on the La Brea fire, where the IMT was able to use existing fuel breaks as containment line from which to burnout, thus reducing the amount of line construction necessary and decreasing total costs.

6. **Land/Resource Management Plans and Fire Management Plans**

Recommendation: When revising LRMPs and FMPs, Federal agencies should include an analysis of potential suppression actions and recognize the suppression constraints and fire behavior conditions that their planning decisions create which may impact fire costs.

This subject is thoroughly discussed in the document: "Large Fire Suppression Costs – Strategies for Cost Management, 2004." We concur with the following recommendations and believe they apply to the six fires we reviewed.

- Understand and display the cost of land management constraints on wildland fire suppression costs.
- Change the expectation for suppression cost by recognizing that many current land management decisions create inherently higher costs of suppression.
- Change the future expectations for total suppression costs. If costs are important they must be considered at all levels, from planning through implementation.

7. **Public Education on Air Operations**

Recommendation: Plan and implement a multi-pronged educational effort directed to the public, the media, and political interests, showing the appropriate uses and limitations of airtankers and heavy helicopters.

The agencies need to help the public, media and politicians to understand when fire agencies can succeed with aviation assets, particularly aerially delivered retardant, and when they cannot; and help those audiences adjust their expectations relative to the use of aviation assets. The agencies could also further empower both agency administrators and ICs to say "no" to pressure to inappropriately use retardant or heavy helicopters.

8. **National Mobile Food Services Contract**

Recommendation: Allow more flexibility in the application of the National Mobile Food Services Contract to allow for locally acquired food service alternatives when savings can be demonstrated.

National contracts, particularly for catering, can drive costs up in some circumstances, particularly on fires with low to moderate staffing. The Federal agencies should renegotiate the contracts with national caterers to raise the threshold at which the Federal wildland fire agencies are obligated to order services from the MFSU Contractors. Allow local units the flexibility to use an alternative to a nationally contracted MFSU. For example, the government could elect to use a local alternative when the number of meals being served on the incident remained below, or fell below, 900 and incident personnel could demonstrate a savings by using a food service alternative.

9. Agreements

Recommendation: Evaluate the cost provisions of existing cooperative agreements with state and local cooperators in California and renegotiate where necessary.

Examine whether Federal agencies should be obligated to pay plans negotiated between cooperators and their employees, such as portal-to-portal payment and overtime rules; as well as high overhead rates, administrative fees, minimum commitment requirements and other factors in an effort to reduce the cost of these agreements. Payment to cooperators should be limited to those that reimburse the cooperator for added incremental costs incurred by the cooperator as a result of participating in the fire.

The current agreements can cause incident management organizations to use much higher cost local and state resources rather than more cost effective Federal resources. Examine portal-to-portal payment and overtime rules, high overhead rates, administrative fees, minimum commitment requirements and other factors in an effort to reduce the cost of these agreements. Improved agreements offer the potential to reduce fire suppression costs by millions of dollars on fires such as the six we reviewed, as well as others both in California and possibly elsewhere. (Our understanding is that the Forest Service's Region 5 is working on the agreement issue.) The Forest Service should also examine right-sizing their organization to achieve a cost-effective workforce size and capability that enables the agency to reduce its dependence on state and local government resources in California.

Decision Support Tools, New Technology and Guidance

Incident management teams, agency administrators, and other forest personnel made effective use of available decision support tools on the national forests and in the national park responsible for the fires reviewed. The decision-makers on each of the six fires gave the new tools good marks, and said they helped with decision making, as well as documenting and communicating risk management and cost management decisions.

Wildfire Decision Support System – Consistent with agency policy, the Forest Service and the NPS employed the WFDSS on all six fires reviewed. In some cases, the responsible unit was in its first year of using WFDSS, while others had been using the system for up to a year longer.

Reflecting a problem with variable experience, some who read the maximum predicted extent section in WFDSS took the estimate of the maximum predicted extent of the fire to mean the planned line to hold. WFDSS instructions or forms need to be clear that the predicted maximum extent was not necessarily the target for the strategy selected.

On the other hand, this situation can be further rectified by making long term assessment an integrated part of WFDSS, with strategic management action points clearly defined.

Most personnel the Panel interviewed seemed to believe that WFDSS primarily served to confirm or validate decisions and then communicate those decisions to others. We believe that this may have been the case because the decision-makers were mostly local employees who knew the areas and the operating conditions around in and in the fire area very well. However, had IMT personnel been less familiar with local conditions, the information provided by WFDSS would have been more critically important to effective decision-making.

10a. Recommendation: The Forest Service and NPS should provide more and better training on WFDSS for their personnel, including agency administrators, their staffs and IMT members.

On the Williams Creek fire, personnel on Oregon's Umpqua National Forest ordered a NIMO team to prepare a long-term assessment to supplement their WFDSS analysis. This appeared to represent an effective practice, and appeared to provide an excellent way to expand upon the capabilities of WFDSS.

We also heard a variety of comments on the use of the Key Decision Log. In general most felt, that incident personnel needed to be better prepared to use this tool and that the developers and proponents need to better explain its intended purpose and practical use. On the other hand, a number of incident personnel believe the value of the KDL lies in documenting lessons learned for future learning, and thought it should be integrated into WFDSS.

10b. Recommendation: Revise WFDSS to incorporate the KDL and long-term assessment, so that users can access and use all key decision support tools in one place. Also, make it easier to print hard copy from WFDSS, including maps.

FSPro – FSPro is a computer model for predicting fire growth by various probabilities. FSPro is a module within WFDSS. This tool was used on all fires we reviewed, and was an important decision making tool.

10c. Recommendation: Provide more and better training for agency personnel to use, interpret, and understand the outputs of FSPro.

RAVAR – RAVAR is a computer model for identifying values at risk, such as: structures, power lines, and natural features. Overlaying these values, on the FSPro maps to show the risks in relation to the predicted extent of the fire can be useful. Decision-makers used RAVAR on most of the six fires, which demonstrated that values at risks were explicitly taken into account in formulating strategies. However, users know that RAVAR does not adequately model values at risk such high value commercial timber.

10d. Recommendation: RAVAR needs to be able to better account for a broader range of values, such as commercial timberland.

Infrared – Infrared imaging devices including forward-looking infrared (FLIR) were used on air attack aircraft to provide fire managers with unobscured views of the fire, unimpeded by smoke. One advantage that user's found was that IR equipped air attack aircraft reduced the need to withdraw firefighters from the fireline, because conditions were unknown. With crews costing many thousands of dollars per day, disengagement, and the resulting loss of productivity, can represent a significant cost.

11. Recommendation: Encourage use of IR equipped air attack platforms. While their initial costs appear to be higher, their use can result in significant cost savings that justify the relatively higher initial expense. Conduct further research into opportunities to maximize the use of IR technology, including additional platforms, such as un-manned aerial vehicles also known as drones.

Supply Accountability – Supply costs represent one of the larger indirect costs. On some fires the loss/use ratio for supplies exceeded the target ratio of 15%. The Williams Creek fire employed a bar coding that tied issued supplies and equipment to individual personnel via a card system to improve the ability to track and account for supplies and equipment and experienced a low loss/use ratio.

12. Recommendation: Use bar code and smart card technologies to track and account for non-expendable supplies to the extent possible.

Metrics

As part of reviewing the past cost review reports, we considered the metrics being used to reflect agency performance on fires. Of course, the total cost represents a primary measure. In the section (in the final report) on cost analysis, we analyzed the components of the total costs in various ways to give insight into cost containment and the drivers of costs. We comment below on two common measures, and offer a new measure to better reflect cost-benefit of wildland firefighting.

Cost Per Acre – Federal agencies commonly use this metric to estimate costs early in the fire, and to predict the total or eventual cost of the fire. However, beyond this use, the Panel found cost per acre to be a highly questionable measure of success. For example, the highest cost fires reviewed (Station and La Brea) had much lower costs per acre than the other fires reviewed. Larger fires often have lower costs per acre. A unit making a robust initial attack and stopping a fire at a few acres would produce a very high fire cost on a per acre basis, even though the total cost might be less than one percent of what it would have cost if it had escaped. So while this metric should continue to be computed, it does not by itself imply much about cost containment.

Workplace Injuries Per Hours Worked – OSHA uses the number of worker injuries per 100 equivalent worker years as a standard measure of workplace safety. With adaptations to account for the hours worked by wildland firefighters, the agencies could compute a similar metric to empirically measure lost time injuries rates for wildland fires. Some fires reviewed made this kind of computation, and seemed a good way to assess performance on firefighter safety.

13a. Recommendation: Adapt the OSHA standard for measuring workplace safety and implement it as a means for empirically measuring lost time injuries rates for wildland fires.

New Metric--Losses Averted – The final reports on the large fires (and most other fires) do not explicitly show what the citizens got for their money. While the agencies report a cost figure for the fire and data on losses, such as acres burned and houses destroyed, but does not, conversely, report on what the fire suppression effort saved. We suggest that agencies develop a new metric for use in the final fire narrative, to estimate property and lives saved, including the estimated value saved.

Agency personnel identified the number of homes and other properties at risk using RAVAR analysis on most of the fires we reviewed. In some cases, they attached a dollar value. On each of these large fires, analysts used FSPro to predict the likely extent of the fire given the range of potential weather conditions, and if no firefighting actions were taken. Thus the potential extent of damage already is part of WFDSS considerations and can be used after the fact to measure performance.

At the end of the fire, the agency knows the actual fire weather, and can re-run the FSPro model using actual conditions, to better estimate the extent of the fire had suppression action not been taken. One can then overlay the property at risk on the computed extent of the fire to estimate what the effort likely saved. One could then say something like, "We spent $10M to suppress this fire and it is 90% likely that we saved 100 homes valued at $2.5M, 50% likely we saved another 300 homes valued at $7.5M, and 10% likely that we saved yet another 1000 homes valued at $25M. Potentially, similar statements could be made regarding transmission lines and other high value assets. For example, on the Station fire, suppression efforts prevented damage to observatory and communication facilities valued at $500M on Mount Wilson alone. Similarly, when the final fire acreage is known, analysts could quickly and easily use FSPro to help assess whether fire effects proved consistent with the unit's land management and fire management plans. Finally, the agencies could even measure the value of lives saved. For example, on the Station fire, law enforcement personnel helped 79 people out of the Angeles Forest in advance of the flames.

A suite of property conservation metrics would put the large fire cost review process on more of a cost-benefit footing, which would provide Congress and Department managers with a much more effective and meaningful measure of performance. On the Station fire, which cost $94M, fire suppression efforts likely conserved more than $1B in property, which puts this fire in a very different light.

13b. Recommendation: Consider developing metrics for estimating values conserved, comparing them to fire costs, and taking a cost-benefit approach to measuring fiscal performance.

The specific metrics that can be used are:

- Estimated economic value saved (e.g. from homes, timberland, communication towers, power lines, and the shorter duration of evacuations, road closures, power line closures).
- Wildland acreage saved. The acreage burned is known; some part of that may be considered desirable. The acreage saved can be computed from running FSPro at the end of a fire with the actual weather during the fire to predict more accurately what the fire might have done if it had not stopped where it was.
- Lives saved. It may be more difficult to estimate the lives saved than property saved because many people essentially save themselves. However, some saves are clearly attributable to firefighters. For example, incident personnel helped 79 people leave areas of the Station fire before they burned. Narratives are needed to explain lives saved with credibility.

Improving the Cost Review Process

The agency personnel that our panel interviewed gave past large fire cost reviews fairly low marks for usefulness. Some "lessons learned" do filter into training and practice, but the Congress and the Departments of Agriculture and Interior can clearly improve the process. It appears that incident personnel do a better job of documenting their decisions because they are aware that costs represent a major concern. However, agency personnel report that cost review recommendations are often too general, and the same findings and recommendations are repeated year-after-year without being either implemented or tracked

Organizational Learning and Continuous Improvement – As part of our effort, we reviewed each of the last four reports produced by the Secretary's Independent Panels. None found evidence of fiscal malfeasance, lack of diligence, or imprudent management; and our review of the 2009 fires proved consistent with those previous findings.

Perhaps it is time to turn the review process in a new direction. The panel believes that Federal fire agencies will most improve their fire suppression cost control, not by additional oversight, but through organizational learning and continuous improvement. Organizational learning is a process by which organizations acquire knowledge they need to survive and perform in their environments, including development of shared knowledge and understanding that leads to effective action. A learning organization is skilled at continuously gaining knowledge and insights, and then purposefully modifying their behavior to reflect that new knowledge and those insights (Garvin, 2000). It is this approach that our panel believes should characterize future review efforts

14a. Recommendation: Replace the current Large Fire Cost Review process with one less oriented to oversight and more oriented to organizational learning.

Consider a process more like facilitated learning analyses used in the wildland fire community to examine near miss events in fire operations. Continue with a structured, intensive, and independent review, but orient the process to controlling fire costs by maximizing learning opportunities, improving performance, and capitalizing on shared experience.

Dissemination and Implementation – We found that the dissemination of the previous reports did not always reach the people in the field who actually make strategic and tactical decisions that drive fire suppression costs so that they had opportunity to implement the recommendations contained in those reports. The past reports may or may not have been intended to reach them these people, but we believe they should have been.

14b. Recommendation: The agencies should ensure that their field personnel have received and are adequately implemented cost review recommendations. Reporting on implementation of previous review recommendations should part of the subsequent year's review.

Reduced Redundancy – Agency and Congressional requirements, when combined, cause the agencies to conduct too many reviews and conduct them at different levels.

14c. Recommendation: The agencies should create a single suite of reviews, with the largest fires (above a threshold cost) receiving independent review, as at present. The resulting system should not include separate cost containment reviews and large fire cost reviews.

Congressional Reporting Threshold – There are many similarities among fires with final costs greater than $5M. In some years, many fires exceed this threshold. Even at the $10M threshold there were 27 such fires in 2007 and 22 fires in 2008. When it comes to reviewing large fire costs, congress and the departments should emphasize quality of review over quantity of reviews.

14d. Recommendation: Consider a more productive review strategy, in which each fire costing more than $20M and a sample of fires in the $5M to $20M range are reviewed in depth. The sample should reflect both the range of costs, agency jurisdiction, and geographic location.

Consistent Reviews – The current annual large cost fire review approach tends to produce isolated efforts and unrelated recommendations, rather than establishing a consistent foundation for continuous improvement.

14e. Recommendation: Consider engaging a review contractor and panel for a multi-year period. Doing so will provide more consistent reviews and reduce review costs.

Alternative: Initiate Review Process Sooner and Provide Adequate Time –The time frame given the contractor in 2009 proved extremely ambitious and precluded approaches, services and deliverables that would maximize the review's benefits. If a multiyear review contract is not used, then the performance period should be started sooner and made longer.

14f. Recommendation: The government, when soliciting the services of the review contractor should:

- Prepare the contract solicitation prior to the new fiscal year, pending the list of fires meeting the inclusion threshold (which may not be known until after the fiscal year ends.)
- Decide which fires will be reviewed as soon as possible after the fiscal year ends.
- Award the contract by December 1
- Complete the analysis and report in late March/early April
- Have the contractor, assisted by agency personnel, brief key agency personnel at IMT meetings, regional fire meetings, regional and national workshops, and/or other regional and national venues prior to fire season

This page intentionally left blank.

APPENDIX A. REVIEW PANEL SHORT BIOS

Project Management

Michael DeGrosky, founder and CEO of the Guidance Group and the Project Manager, is an experienced wildland and municipal fire professional, and an expert facilitator of panels in this field. The Guidance Group is a leading service company specializing in human and organizational assistance to fire service organizations.

DeGrosky's emergency service background spans 34 years, including service as a rural fire forester, fire management specialist, unit fire supervisor, fire program manager volunteer fire department captain, career fire department training officer and consultant to fire and emergency organizations. He has served as a member of interagency IMTs and maintains current qualifications as an Operations Section Chief Type 2 and Incident Commander Type 3.

He has extensive experience conducting focus groups, individual interviews and stakeholder surveys in the conduct of field research and strategic planning in wildland firefighting and related fields. DeGrosky has extensive experience interviewing and facilitating communication between individuals in informal settings.

DeGrosky has been a principal researcher and interviewer for several milestone Forest Service studies, including "Prioritizing Wildland Fire Cost Containment Strategies", Comprehensive Study of [Forest Service Employee] Safety and Health, and the 4-year "Wildland Firefighter Safety Awareness Study", also known as the "TriData Report." He possesses extensive experience in interagency operations and inter-governmental affairs and is a recognized training professional. DeGrosky earned his Master's degree in Organizational Leadership in May 2005 and is currently pursuing a PhD in Business Administration with an emphasis in Organizational Leadership.

Philip Schaenman is President and founder of TriData, a division of System Planning Corporation. He is a senior consultant specializing in risk management for fire operations, and performance metrics for the fire service. He has led three major studies for the Forest Service, including "Prioritizing Wildland Fire Cost Containment Strategies", "Comprehensive Study of [Forest Service Employee] Safety and Health", and the 4-year "Wildland Firefighter Safety Awareness Study", also known as the "TriData Report." He has extensive experience in reviewing major fires, and was responsible for over 50 fire incident reviews for the U.S. Fire Administration. He also was director of the staff coordination the blue ribbon panel review of the Virginia Tech shooting incident.

TriData is known nationally and internationally specializes in performing research and management analysis studies in fire protection, emergency medical services, prevention and public education, emergency management, and homeland security. It has undertaken studies of wildland and urban firefighting, and of volunteer department preparedness for wildland firefighting, including in California and Oregon. He also led studies of wildland fire programs for the states of Washington, Oregon, and Nevada.

Mr. Schaenman previously was Associate Administrator of the U.S. Fire Administration from 1976–1981, where he was responsible for the National Fire Data Center and fire protection technology, including development of the new generation of firefighter protective clothing. Mr. Schaenman is an electrical engineer by training, with advanced degrees from Stanford and Columbia Universities. Schaenman has received awards from his parent company, System Planning Corporation, as Best Manager and the Chairman's Award, the top honor in the company.

Panelists

Donald Artley (retired) contracts part-time with the International Association of Fire Chiefs (IAFC), and is an ex-officio member of their Wildland Fire Policy Committee. Between 2002 and 2007, he was the National Fire Director for the National Association of State Foresters and worked out of the National Interagency Fire Center (NIFC) in Boise, Idaho. Prior to that, he spent a decade as Montana State Forester, and held other positions with the Forestry Division of the Montana Department of Natural Resources and Conservation. Mr. Artley was a member of the National Multi-Agency Coordinating Group (NMAC) and chaired that organization from 2002 through 2007. He served on the National Fire & Aviation Executive Board (NFAEB) from 2002-2007, and the National Wildfire Coordinating Group (NWCG) from 1994 through 2002; serving as the NWCG Chair from 1996-2002. Don was a member of the National Association of State Foresters (NASF) Forest Fire Protection Committee for nine years. He has also served as a team member on several high profile wildland fire initiatives, including serving on the Management Oversight Team for the implementation of the 1995 Federal Wildland Fire Management Policy and as a team member for both the development of the 2001 Revised Federal Wildland Fire Management Policy and the "Large Fire Cost Reduction Action Plan" (March 2003). Artley co-Chaired the Wildland-Urban Interface Working Panel for the Forest Service's 2009 Quadrennial Fire Review (QFR).

Richard Mangan is a nationally and internationally recognized wildland fire expert with extensive experience in the fields of wildland fire management, firefighter safety, and risk-based decision-making. He is the owner/president of Blackbull Wildfire Services, LLC, a wildland fire consulting company that he formed in 2001 after retiring from the U.S. Forest Service in December 2000. Mr. Mangan has a Bachelor of Science degree in Forestry from Humboldt State University, and has completed numerous wildland fire management courses offered through the National Wildfire Coordinating Group, including S-520 Fire Generalship; S-420 Fire Organization and Management; Senior Level Aviation Management; S-400 Incident Commander; S-440 Planning Section Chief; S-404 Safety Officer; and Fire Behavior for Managers.

Mr. Mangan's wildland fire career began as an entry-level firefighter in 1964, and progressed up to the highest position in the IC system with direct fire suppression supervision responsibilities (Operations Section Chief Type One). He has been qualified as a Type One Operations Section Chief on wildland fire assignments since 1986, with experience on major fires in California, Oregon, Montana, Arizona, Florida, Georgia and other States. He is also fully qualified and current as a Wildland Fire Safety Officer.

In addition, he has served as the permanent Forest Fire Staff Officer on a major western U.S. National Forest of over one million acres (500,000 hectares). His responsibilities included overseeing all aspects of wildland fire management on a year-round basis, including fire prevention, fuels management, fire training, dispatching, and fire suppression.

Mr. Mangan has authored numerous technical reports on all aspects of wildland fire management and safety, and has delivered numerous presentations at Technical and

Scientific Wildland Fire Conferences across the US and also Australia, Siberia, Spain and Portugal. He has conducted reviews of fire management organizations, and has served on numerous wildfire fatality investigations.

Peter Moy, CPA, is a financial consultant with over 30 years of public sector experience. He has a BS in Finance and Organizational Behavior and Industrial Relations and an MBA in Finance. Mr. Moy has managed and participated in financial and cost effectiveness reviews of many fire departments studies (both with TriData and through FCS Group and Peter Moy & Associates), including Seattle, WA; Tacoma, WA; Portland, OR; Sonoma, CA; Bellevue, WA; Whatcom County, WA; Anchorage, AK; Arlington County, VA; and others. He has worked on projects involving strategic planning, financial and policy analysis, cost of service analysis, organizational development, regional governance, and program and management effectiveness. He provides additional experience in strategic planning, financial management, and operational and cost analysis of fire and emergency medical services.

Paul Woodard is a Professor in the Department of Renewable Resources at the University of Alberta, Edmonton, Alberta, and President of Ram Fire International Inc, a wildland fire consulting company, which he started over 20 years ago. Dr. Woodard has a BSc in forestry from the University of Vermont, an MSc in wildland fuels measurement, and a PhD in forest fire ecology; the last two degrees were from the University of Washington in Seattle. Over the years he has completed Forest Service training in the areas of fuel management, prescribed fire and advance fire management.

Dr. Woodard teaches in the areas of wildland fire management, fuels measurement, and wildland fire ecology. Throughout his career he has supervised over 15 graduate students, post-docs, and visiting scientists from around the world. He has published over 130 manuscripts in such areas as the effects of fire on a number of northern wildlife species and plant communities, fireline productivity rates in the Boreal Forest, the use of infrared technology in fire control, wildland fire evidence gathering requirements, and fuels measurement and management. Additionally, he has served as a: prescribed fire boss, fire fighter, Dispatcher, Sector Boss, and an expert witness in the area of wildland fire investigation and damage appraisal. Dr. Woodard has provided legal opinions in three Provinces and two states. He has Chaired three international wildland fire conferences, and was the Associate Editor of Fire for The Forestry Chronicle for over 10 years.

In the 33 years Dr. Woodard was at the University of Alberta, he served on General Facilities Council, was the Associate Dean – Research in the Faculty of Agriculture, Forestry, and Home Economics, and was the President of the Association of Academic Staff: University of Alberta. He was awarded the Canadian Forestry Achievement Award from the Canadian Institute of Forestry in 2005, and was the recipient of their Tree of Life Award.

Philip Schaenman is also a panelist; his background is given above as Deputy Project Manager.

APPENDIX B. QUESTIONS ASKED IN INTERVIEWS

1. What factors or issues contribute most to the cost of fire suppression on your Forest and why?
2. What impediments to effectively managing fire suppression costs are outside of your control?
3. What outcomes of this fire were good and which could be improved? For example, could you have reduced the losses by any cost effective approaches, or could the same outcomes have been produced at a lower cost?
4. What were the critical factors that drove strategy and decision-making on your fire?
5. On the day of ignition, given the existing fire danger, were all planned initial attack resources available?
6. In general, do you believe your Forest has the resources needed to aggressively and effectively attack all fires? Specifically, do you have the resources to deal with all IA and sustain fire operations?
7. When your IMT arrived, who prepared and signed the delegation of authority and who briefed the teams?
8. Did the in-brief adequately communicate the line officer’s intent? Specifically, how did the line officer communicate about critical factors and influences to the incoming IMT so that strategy translated to tactics and decision-making?
9. Was cost containment a major objective? Were any specific cost constraints included in the delegations of authority (such as limits on use of large airtankers)?
10. How did the line officer provide oversight to assure that tactics and decisions were consistent with the strategy and, further, that the strategy was consistent with line officer’s intent?
11. Describe your view on how one manages the role/relationship between line officers and IMTs so that Forest Service fire efforts prove efficient and effective?
12. When were your Forest and Fire Management Plans last updated? Do those plans directly address fire suppression cost containment strategies?
13. How did the Forest Plan and Fire management Plan affect your decisions regarding this fire? What feeds those decisions?
14. Please tell us about the written interagency agreements your Forest had with both state and local fire service cooperators prior to the 2009 fire season? Specifically, did these agreements include a discussion of how suppression costs would be shared on multi-jurisdictional fires and were they helpful in reducing suppression costs?
15. What specific fire prevention and fuel reduction efforts (if any) were carried out in the fire area prior to the fire? What affect did these efforts have on fire control and the cost of control?
16. Did structure protection contribute significantly to the suppression costs of this incident? Were the structure protection costs appropriately shared with the state or local fire services?

17. What new processes, guidance or tools (including technology) did you employ, and to what effect?
18. What makes a good WFDSS document, one that lets people know what “right looks like” and what performance is expected of them?
19. How have you implemented the recommendations from recent suppression cost reduction reports (such as Large Fire Cost Reduction Action Plan, March 2003, Large Fire Suppression Cost Strategies for Cost Management, August 2004)? Specifically, have you received specific direction from the Region or the Washington Office to implement the recommendations from such reports?
20. Is there anything we did not specifically ask, that you think we need to know?

This page intentionally left blank.

APPENDIX C. GLOSSARY OF ACRONYMS

Acronym/Term	Definition
Agency Administrator	A District Ranger, Forest Supervisor, or Park Superintendent. The Agency Administrator is the highest-ranking agency line officer with direct responsibility for the personnel involved in the incident. Agency Administrators are responsible for the overall management of critical incidents within their jurisdictions.
AOP	Annual Operating Plans
CAL FIRE	California Department of Forestry and Fire Protection
DFPA	Douglas Forest Protection Association
DOA	Delegation of Authority
DPA	Direct Protection Area
FLIR	Forward Looking Infrared
FMP	Fire Management Plan
FSPro	Computer model used in predicting fire growth with various probabilities
GACC	Geographic Area Coordinating Center
IBA	Incident Business Advisor: The IBA serves as a “bridge” to the AA, IMT, and other incident support functions. This “bridge” provides a communication flow to assigned resources with the focus being successful incident business management practices.
IC	Incident Commander: Person(s) responsible for managing an emergency in terms of coordination, mitigation, preparedness, control, and recovery.
IMT	Incident Management Team: The IC and appropriate command and general staff personnel assigned to an incident. Incident Management starts as the smallest unit and escalates according to the complexity of the emergency. The five types of IMT are as follows: Type 5 (very small wildland fire only) • Initial attack • Short duration seldom lasting into the next burn period • Few resources assigned (generally less than 6 people) • Little complexity Type 4 • Initial attack or first response to an incident • IC is a "hands on" leader and performs the all functions of Ops, Log, Plans, Finance • Few resources are used (several individuals or a single strike team) • Normally limited to one operational period • Does not require a written incident action plan Type 3 • Extended initial attack on wildland fires • IC walks the line between a manager and a doer • Resources may vary from several single resources to several task forces or strike teams • Some Command/General Staff positions (Division/Group supervisor, unit leader) may be filled • May extend into another operational period/l2hrs and require IAP

Acronym/Term	Definition
	Type 2 • IC spends all time being a manager • Most Command and General staff positions are filled • Large number of resources utilized • Incident extends into multiple operational periods • IAP required for each operational period • Base camp(s) established • Significant logistical support is required Type 1 • All functions are filled, plus leaders, branches etc. • Multi-agency and national resources • Large number of personnel and equipment are assigned to the incident • It is a large, complex incident
IR	Infrared
KDL	Key Decision Log
LRMP	Land/Resource Management Plan
MFSU	National Mobile Food Service Unit
NIMO	National Incident Management Organization
NPS	National Park Service
ODF	Oregon Department of Forestry
OSHA	Occupational Safety and Health Administration
RAVAR	Computer model used in identifying risks
Spike Camp	Remote camp usually near a fireline, and lacking the logistical support that a larger fire camp would have.
VLAT	Very Large Airtanker
WFDSS	Wildfire Decision Support System
WUI	Wildland-Urban Interface

APPENDIX D. LITERATURE REVIEWED

The Panel reviewed the following documents in an attempt to understand previous efforts and directives pertaining to large fires cost containment. In addition, we reviewed documents, reports, summaries of events, and financial records pertaining to the six fires we analyses as part of this specific review effort. Specifically, we reviewed, studied, and evaluated the following documents and evidence:

- Black, A. (2009). Key decisions in incident management – a PowerPoint presentation presented at the 2nd International Conference on Human Dimensions in Wildland Fire, April 26, 2010, San Antonio, TX. (in press)
- Canton-Thompson, J., B. Thompson, K. Gebert, D. Calkin, G. Donovan, and G. Jones. (2006). Factors affecting fire suppression costs as identified by incident management teams. USDA Forest Service Research Note RMRS-RN-30. 10pp.
- Canton-Thompson, J., K. M. Gebert, B. Thompson, G. Jones, D. Calkin, and G. Donovan. (2008). External human factors in incident management team decision making and their effect on large fire suppression expenditures. Journal of Forestry December: 416 – 424.
- Dalton, Patricia. (2009). Wildland fire management – Federal agencies have taken important steps forward, but additional action is needed to address remaining challenges. This document was the written testimony before the Committee on Energy and Natural Resources, U.S. Senate on 21 July 2009. See GAO-09-906T or http://www.gao.gov/new.items/d09906t.pdf.
- ECONorthwest. (2009). Fiscal year. (2008). Large-Cost Fire Independent Review. Available from ECONorthwest, 99 W. 10 Avenue, Suite, Eugene, OR.
- Garvin, D. (2000). *Learning in Action: A Guide to Putting the Learning Organization to Work.* Harvard Business School Press.
- U.S. Forest Service. (2009). FSM 5100 – Fire Management/Chapter 5190 Management, paragraph 5194.14 – Regional Large Fire Cost Reviews.
- U.S. Forest Service & Department of the Interior. (2009). Guidance for implementation of Federal wildland fire management policy. http://www.nifc.gov/policies/guidance/GIFWFMP.pdf
- U.S. Forest Service & Department of the Interior. (2009). Interagency standards for fire and aviation operations. NFES 2724.
- U.S. Forest Service, Department of the Interior, and the National Association of State Foresters. (2009). Quadrennial Fire Review 2009. A publication available from the National Interagency Fire Center, Boise, ID or http://www.nifc.gov/QFR/QFR2009Final.pdf
- U.S. Forest Service & Department of the Interior. (2008). Interagency Large Fire Cost Review Guidebook. http://www.fs.fed.us/fire/publications/guidebook.pdf
- U.S. Forest Service & Department of the Interior. (2008). 2007 U.S. Forest Service & Department of the Interior Large Fire Cost Review. http://www.fs.fed.us/fire/publications/ilwc-panel/report-2007.pdf

- Strategic Issues Panel on Fire Suppression Costs. (2004). Large fire suppression costs – strategies for cost management. http://www.fs.fed.us/fire/ibp/cost_accounting/costmanagement_aug_04.pdf

Specifically related to our six target fires (Knight, Backbone, LeBrea, Station, Big Meadow, Williams Creek)

- Letters of Delegation
- Key Decision Logs (KDL)s
- Wildland Fire Decision Support System (WFDSS)
- Incident Status Summary Reports (ICS-209)
- Cost Containment Forms
- Incident Action Plans (ISP)s
- Cost share agreements for Knight, La Brea, Station, Williams Creek
- IMT Final Fire Narrative

APPENDIX E. DAILY COST DETAIL FOR EACH FIRE

Table 17: Daily Costs by I-Suite Category

Date	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
Backbone									
7/4/2009	8,320	-	-	4,525	**12,845**	2,043	700	**2,743**	**15,588**
7/5/2009	367,140	5,075	116,355	32,307	**520,877**	64,851	25,382	**90,233**	**611,110**
7/6/2009	361,514	4,988	127,635	35,861	**529,998**	133,331	50,179	**183,510**	**713,508**
7/7/2009	399,562	2,713	156,369	31,558	**590,202**	130,622	66,465	**197,087**	**787,289**
7/8/2009	206,733	2,713	200,258	49,213	**458,917**	156,529	113,042	**269,571**	**728,488**
7/9/2009	217,243	2,713	283,777	63,828	**567,561**	156,010	123,250	**279,260**	**846,821**
7/10/2009	358,951	7,211	324,923	74,865	**765,950**	174,402	134,661	**309,063**	**1,075,013**
7/11/2009	415,223	18,385	404,156	81,212	**918,976**	238,256	142,972	**381,228**	**1,300,204**
7/12/2009	280,201	16,268	401,648	80,802	**778,919**	231,785	139,939	**371,724**	**1,150,643**
7/13/2009	371,456	18,108	410,829	81,092	**881,485**	252,801	144,212	**397,013**	**1,278,498**
7/14/2009	393,689	17,714	411,784	79,744	**902,931**	256,999	149,013	**406,012**	**1,308,943**
7/15/2009	374,438	19,259	398,232	81,254	**873,183**	278,317	154,478	**432,795**	**1,305,978**
7/16/2009	287,671	19,149	354,356	74,789	**735,965**	248,779	156,711	**405,490**	**1,141,455**
7/17/2009	155,135	17,847	334,638	57,299	**564,919**	227,996	153,208	**381,204**	**946,123**
7/18/2009	196,797	18,729	284,902	53,484	**553,912**	268,768	156,306	**425,074**	**978,986**
7/19/2009	207,878	16,695	204,892	39,532	**468,997**	194,056	151,636	**345,692**	**814,689**
7/20/2009	109,880	14,508	136,381	33,323	**294,092**	187,379	148,364	**335,743**	**629,835**
7/21/2009	58,912	6,456	95,189	23,421	**183,978**	195,439	95,441	**290,880**	**474,858**
7/22/2009	81,028	6,370	68,286	12,811	**168,495**	182,643	84,859	**267,502**	**435,997**
7/23/2009	64,044	4,900	48,972	9,450	**127,366**	154,295	72,088	**226,383**	**353,749**
Total*	4,915,815	219,801	4,763,582	1,000,370	**10,899,568**	3,735,301	2,262,906	**5,998,207**	**16,897,775**
Big Meadow									
8/26/2009	297,649	25,430	76,041	20,113	**419,233**	10,830	17,976	**28,806**	**448,039**
8/27/2009	665,257	139,787	174,356	61,419	**1,040,819**	105,046	130,294	**235,340**	**1,276,159**

Date	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
8/28/2009	464,913	401,001	208,746	81,483	**1,156,143**	188,407	216,402	**404,809**	**1,560,952**
8/29/2009	790,176	423,412	214,850	85,017	**1,513,455**	200,011	240,692	**440,703**	**1,954,158**
8/30/2009	493,758	430,892	247,723	77,712	**1,250,085**	206,793	223,615	**430,408**	**1,680,493**
8/31/2009	290,619	427,913	256,707	88,915	**1,064,154**	217,757	228,551	**446,308**	**1,510,462**
9/1/2009	376,871	422,666	265,437	87,023	**1,151,997**	243,759	222,335	**466,094**	**1,618,091**
9/2/2009	71,249	387,933	261,501	83,046	**803,729**	280,490	217,481	**497,971**	**1,301,700**
9/3/2009	211,578	356,611	268,923	83,524	**920,636**	218,214	151,440	**369,654**	**1,290,290**
9/4/2009	84,655	225,884	262,758	79,438	**652,735**	232,869	150,441	**383,310**	**1,036,045**
9/5/2009	41,715	126,831	218,950	71,061	**458,557**	175,099	144,304	**319,403**	**777,960**
9/6/2009	20,806	111,016	185,480	67,647	**384,949**	180,953	136,070	**317,023**	**701,972**
9/7/2009	4,280	100,865	123,742	64,936	**293,823**	225,816	127,924	**353,740**	**647,563**
9/8/2009	5,429	40,572	53,259	41,030	**140,290**	97,813	107,145	**204,958**	**345,248**
9/9/2009	3,141	36,064	33,741	17,326	**90,272**	19,507	26,519	**46,026**	**136,298**
9/10/2009	-	27,279	35,674	16,914	**79,867**	17,227	21,481	**38,708**	**118,575**
9/11/2009	-	21,459	35,254	18,558	**75,271**	17,864	20,764	**38,628**	**113,899**
9/12/2009	1,452	17,109	40,774	14,097	**73,432**	15,919	18,721	**34,640**	**108,072**
9/13/2009	-	9,522	34,442	7,872	**51,836**	19,256	13,359	**32,615**	**84,451**
9/14/2009	-	9,451	23,618	6,877	**39,946**	9,526	6,592	**16,118**	**56,064**
9/15/2009	-	6,863	23,460	5,234	**35,557**	9,826	5,131	**14,957**	**50,514**
9/16/2009	-	6,863	22,515	4,334	**33,712**	9,438	4,483	**13,921**	**47,633**
9/17/2009	-	4,883	22,358	1,850	**29,091**	9,438	2,774	**12,212**	**41,303**
9/18/2009	-	4,883	14,640	1,200	**20,723**	9,672	1,120	**10,792**	**31,515**
9/19/2009	-	-	1,920	-	**1,920**	7,305	580	**7,885**	**9,805**
Total*	3,823,548	3,765,189	3,106,869	1,086,626	**11,782,232**	2,728,835	2,436,194	**5,165,029**	**16,947,261**
Knight									
7/26/2009	212,829	39,841	34,736	9,013	**296,419**	1,952	10,910	**12,862**	**309,281**
7/27/2009	294,701	137,253	132,197	59,448	**623,599**	161,281	86,612	**247,893**	**871,492**
7/28/2009	353,279	129,238	225,120	73,768	**781,405**	121,590	109,624	**231,214**	**1,012,619**

Date	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
7/29/2009	264,619	187,482	253,836	75,355	**781,292**	164,705	111,814	**276,519**	**1,057,811**
7/30/2009	185,246	194,716	260,595	80,010	**720,567**	190,945	131,134	**322,079**	**1,042,646**
7/31/2009	317,734	250,965	280,199	81,620	**930,518**	208,108	167,362	**375,470**	**1,305,988**
8/1/2009	125,394	229,514	278,922	80,433	**714,263**	230,125	169,244	**399,369**	**1,113,632**
8/2/2009	149,444	233,249	293,858	80,400	**756,951**	265,222	174,958	**440,180**	**1,197,131**
8/3/2009	116,945	210,799	292,728	74,468	**694,940**	208,470	168,058	**376,528**	**1,071,468**
8/4/2009	61,203	181,554	237,204	74,643	**554,604**	173,108	153,446	**326,554**	**881,158**
8/5/2009	48,484	123,375	149,782	71,100	**392,741**	245,317	118,645	**363,962**	**756,703**
8/6/2009	55,383	92,265	67,078	65,160	**279,886**	177,626	86,579	**264,205**	**544,091**
8/7/2009	3,692	55,089	54,516	52,300	**165,597**	145,294	70,088	**215,382**	**380,979**
8/8/2009	5,232	46,309	54,884	30,643	**137,068**	49,740	29,774	**79,514**	**216,582**
8/9/2009	645	31,573	41,193	18,793	**92,204**	20,348	9,609	**29,957**	**122,161**
8/10/2009	2,423	31,573	29,800	15,940	**79,736**	17,198	4,718	**21,916**	**101,652**
8/11/2009	-	32,478	18,235	4,377	**55,090**	13,508	3,731	**17,239**	**72,329**
8/12/2009	-	18,428	-	1,525	**19,953**	4,028	1,880	**5,908**	**25,861**
8/13/2009	-	17,243	-	1,525	**18,768**	2,828	1,940	**4,768**	**23,536**
8/14/2009	-	9,712	-	400	**10,112**	1,828	820	**2,648**	**12,760**
8/15/2009	-	-	-	-	**-**	-	560	**560**	**560**
8/16/2009	-	-	-	-	**-**	-	560	**560**	**560**
8/17/2009	-	-	-	-	**-**	-	660	**660**	**660**
8/18/2009	-	-	-	-	**-**	-	680	**680**	**680**
8/19/2009	-	-	-	-	**-**	-	120	**120**	**120**
Total*	2,197,253	2,252,656	2,704,883	950,921	**8,105,713**	2,403,221	1,613,526	**4,016,747**	**12,122,460**
La Brea									
8/8/2009	244,687	23,500	87,396	4,340	**359,923**	13,596	7,140	**20,736**	**380,659**
8/9/2009	691,882	47,333	172,316	32,215	**943,746**	204,837	87,154	**291,991**	**1,235,737**
8/10/2009	659,502	165,481	384,137	46,433	**1,255,553**	343,540	126,923	**470,463**	**1,726,016**
8/11/2009	719,175	236,041	526,425	57,505	**1,539,146**	310,317	158,151	**468,468**	**2,007,614**

Date	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
8/12/2009	851,317	351,363	620,672	65,864	**1,889,216**	391,624	178,239	**569,863**	**2,459,079**
8/13/2009	1,140,489	402,640	632,275	73,686	**2,249,090**	413,375	189,536	**602,911**	**2,852,001**
8/14/2009	1,036,065	407,549	624,589	82,738	**2,150,941**	468,393	191,837	**660,230**	**2,811,171**
8/15/2009	787,271	415,657	647,119	88,912	**1,938,959**	448,945	191,990	**640,935**	**2,579,894**
8/16/2009	557,357	373,980	646,001	90,493	**1,667,831**	414,048	194,823	**608,871**	**2,276,702**
8/17/2009	939,928	319,903	633,878	84,631	**1,978,340**	421,352	193,129	**614,481**	**2,592,821**
8/18/2009	396,349	302,890	608,254	82,685	**1,390,178**	411,999	184,893	**596,892**	**1,987,070**
8/19/2009	498,527	283,635	605,297	79,220	**1,466,679**	378,698	183,335	**562,033**	**2,028,712**
8/20/2009	487,731	233,112	522,643	71,269	**1,314,755**	342,615	166,911	**509,526**	**1,824,281**
8/21/2009	241,177	212,184	395,231	66,984	**915,576**	359,126	158,953	**518,079**	**1,433,655**
8/22/2009	173,166	201,259	301,201	69,902	**745,528**	282,841	169,384	**452,225**	**1,197,753**
8/23/2009	163,894	184,536	164,022	63,817	**576,269**	263,967	173,497	**437,464**	**1,013,733**
8/24/2009	85,397	162,157	150,153	57,012	**454,719**	205,763	160,041	**365,804**	**820,523**
8/25/2009	60,100	136,959	135,053	37,012	**369,124**	186,659	101,737	**288,396**	**657,520**
8/26/2009	102,591	97,587	100,488	27,495	**328,161**	174,079	95,026	**269,105**	**597,266**
8/27/2009	106,312	85,209	73,723	25,497	**290,741**	147,480	87,161	**234,641**	**525,382**
8/28/2009	48,301	85,344	68,403	21,373	**223,421**	140,777	77,067	**217,844**	**441,265**
8/29/2009	91,934	64,421	47,834	15,385	**219,574**	122,782	73,315	**196,097**	**415,671**
8/30/2009	21,005	49,768	22,850	12,190	**105,813**	361,399	62,021	**423,420**	**529,233**
8/31/2009	20,120	46,035	15,946	4,898	**86,999**	21,801	20,480	**42,281**	**129,280**
9/1/2009	20,120	44,635	15,574	4,898	**85,227**	15,356	12,514	**27,870**	**113,097**
9/2/2009	9,560	20,570	15,208	3,448	**48,786**	9,571	11,954	**21,525**	**70,311**
9/3/2009	9,560	15,842	5,732	1,598	**32,732**	9,518	7,612	**17,130**	**49,862**
9/4/2009	-	18,292	5,732	2,088	**26,112**	7,668	4,382	**12,050**	**38,162**
9/5/2009	-	9,431	5,732	963	**16,126**	6,385	4,002	**10,387**	**26,513**
9/6/2009	-	2,730	5,732	490	**8,952**	3,385	1,752	**5,137**	**14,089**
9/7/2009	-	2,730	5,732	490	**8,952**	3,385	1,692	**5,077**	**14,029**
9/8/2009	-	2,730	5,732	490	**8,952**	3,385	1,692	**5,077**	**14,029**

Date	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
9/9/2009	-	2,450	-	490	**2,940**	2,200	1,692	**3,892**	**6,832**
9/10/2009	-	2,450	-	490	**2,940**	2,978	1,692	**4,670**	**7,610**
9/11/2009	-	2,450	-	490	**2,940**	2,200	1,692	**3,892**	**6,832**
9/12/2009	-	-	-	-	**-**	188	592	**780**	**780**
9/13/2009	-	-	-	-	**-**	-	592	**592**	**592**
9/14/2009	-	-	-	-	**-**	-	592	**592**	**592**
9/15/2009	-	-	-	-	**-**	-	592	**592**	**592**
9/16/2009	-	-	-	-	**-**	-	592	**592**	**592**
9/17/2009	-	-	-	-	**-**	-	592	**592**	**592**
9/18/2009	-	-	-	-	**-**	-	592	**592**	**592**
9/19/2009	-	-	-	-	**-**	188	-	**188**	**188**
Total*	10,163,517	5,012,853	8,251,080	1,277,491	**24,704,941**	6,896,420	3,287,563	**10,183,983**	**34,888,924**
Station									
8/26/2009	174,101	2,765	45,611	6,000	**228,477**	6,318	9,382	**15,700**	**244,177**
8/27/2009	504,757	216,096	171,780	26,555	**919,188**	78,137	81,682	**159,819**	**1,079,007**
8/28/2009	562,874	794,555	301,753	48,019	**1,707,201**	404,532	189,674	**594,206**	**2,301,407**
8/29/2009	914,637	1,441,151	521,481	71,678	**2,948,947**	571,237	328,916	**900,153**	**3,849,100**
8/30/2009	1,077,287	2,037,639	655,476	106,215	**3,876,617**	791,065	499,047	**1,290,112**	**5,166,729**
8/31/2009	985,514	2,348,684	804,201	149,406	**4,287,805**	1,025,486	669,028	**1,694,514**	**5,982,319**
9/1/2009	651,326	2,415,600	859,592	174,027	**4,100,545**	1,093,051	838,195	**1,931,246**	**6,031,791**
9/2/2009	798,062	2,385,231	910,599	159,657	**4,253,549**	1,278,224	921,514	**2,199,738**	**6,453,287**
9/3/2009	512,507	1,949,984	1,066,369	167,895	**3,696,755**	1,176,476	939,171	**2,115,647**	**5,812,402**
9/4/2009	1,249,406	1,749,466	1,063,424	180,051	**4,242,347**	1,157,299	909,993	**2,067,292**	**6,309,639**
9/5/2009	1,205,842	1,496,326	1,072,456	183,075	**3,957,699**	1,099,876	888,193	**1,988,069**	**5,945,768**
9/6/2009	1,195,639	1,109,258	1,092,411	184,965	**3,582,273**	936,693	1,032,728	**1,969,421**	**5,551,694**
9/7/2009	967,752	1,019,502	1,091,687	185,173	**3,264,114**	1,015,060	791,856	**1,806,916**	**5,071,030**
9/8/2009	1,148,794	996,798	1,074,617	195,128	**3,415,337**	1,063,013	764,018	**1,827,031**	**5,242,368**
9/9/2009	632,394	980,023	1,187,445	195,891	**2,995,753**	834,794	722,394	**1,557,188**	**4,552,941**

Date	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
9/10/2009	397,438	729,839	1,041,250	182,390	**2,350,917**	949,041	582,631	**1,531,672**	**3,882,589**
9/11/2009	230,996	518,663	914,030	166,445	**1,830,134**	741,332	500,761	**1,242,093**	**3,072,227**
9/12/2009	183,957	371,471	664,009	141,984	**1,361,421**	543,174	413,229	**956,403**	**2,317,824**
9/13/2009	84,303	247,356	425,138	132,955	**889,752**	335,112	347,004	**682,116**	**1,571,868**
9/14/2009	15,509	176,725	243,017	123,186	**558,437**	376,461	264,547	**641,008**	**1,199,445**
9/15/2009	7,569	158,967	188,935	82,067	**437,538**	366,765	168,000	**534,765**	**972,303**
9/16/2009	32,950	163,956	182,558	63,635	**443,099**	215,859	150,665	**366,524**	**809,623**
9/17/2009	27,380	152,765	142,924	43,757	**366,826**	288,407	120,661	**409,068**	**775,894**
9/18/2009	39,914	161,600	135,523	42,640	**379,677**	193,566	111,510	**305,076**	**684,753**
9/19/2009	226,626	152,263	133,387	42,382	**554,658**	148,835	103,811	**252,646**	**807,304**
9/20/2009	425,236	154,590	155,575	43,107	**778,508**	127,222	102,802	**230,024**	**1,008,532**
9/21/2009	276,595	167,088	160,598	42,987	**647,268**	148,349	97,156	**245,505**	**892,773**
9/22/2009	814,942	191,063	178,533	42,702	**1,227,240**	134,309	97,564	**231,873**	**1,459,113**
9/23/2009	274,605	232,313	190,194	42,932	**740,044**	420,527	98,019	**518,546**	**1,258,590**
9/24/2009	96,826	200,356	169,059	42,965	**509,206**	147,671	96,159	**243,830**	**753,036**
9/25/2009	55,769	183,568	141,492	40,931	**421,760**	183,552	94,141	**277,693**	**699,453**
9/26/2009	78,660	159,535	139,716	38,165	**416,076**	354,276	85,739	**440,015**	**856,091**
9/27/2009	44,413	134,109	126,383	34,124	**339,029**	137,910	78,719	**216,629**	**555,658**
9/28/2009	63,917	118,704	78,692	32,349	**293,662**	126,488	73,302	**199,790**	**493,452**
9/29/2009	17,182	58,346	45,245	17,213	**137,986**	34,425	20,512	**54,937**	**192,923**
9/30/2009	19,713	61,844	64,320	16,758	**162,635**	33,675	14,971	**48,646**	**211,281**
10/1/2009	11,324	63,206	58,007	14,373	**146,910**	32,655	11,101	**43,756**	**190,666**
10/2/2009	15,580	44,276	58,007	13,960	**131,823**	32,275	11,118	**43,393**	**175,216**
10/3/2009	5,920	30,010	27,067	10,300	**73,297**	27,655	10,711	**38,366**	**111,663**
10/4/2009	3,259	23,253	26,767	9,530	**62,809**	27,655	10,680	**38,335**	**101,144**
10/5/2009	2,425	16,136	26,767	9,200	**54,528**	27,655	10,066	**37,721**	**92,249**
Total*	16,033,900	25,615,080	17,636,095	3,506,772	**62,791,847**	18,686,112	13,261,370	**31,947,482**	**94,739,329**

Date	Aircraft	Equipment	Handcrews	Direct Personnel	Subtotal Direct	Indirect Supplies/ Services	Indirect Personnel	Subtotal Indirect	Total
Williams Creek									
7/28/2009	109,095	9,200	19,523	3,695	**141,513**	4,387	2,249	**6,636**	**148,149**
7/29/2009	125,601	32,835	105,455	31,511	**295,402**	73,760	21,054	**94,814**	**390,216**
7/30/2009	93,775	117,806	225,735	62,787	**500,103**	142,350	46,029	**188,379**	**688,482**
7/31/2009	125,140	154,539	258,504	74,276	**612,459**	131,145	53,806	**184,951**	**797,410**
8/1/2009	130,632	189,522	260,376	83,278	**663,808**	163,220	56,304	**219,524**	**883,332**
8/2/2009	194,599	170,881	305,064	85,238	**755,782**	179,687	60,040	**239,727**	**995,509**
8/3/2009	233,667	166,571	334,629	83,534	**818,401**	169,465	63,486	**232,951**	**1,051,352**
8/4/2009	143,581	165,185	317,929	80,115	**706,810**	159,919	62,955	**222,874**	**929,684**
8/5/2009	171,267	152,562	309,082	89,149	**722,060**	184,846	63,392	**248,238**	**970,298**
8/6/2009	95,343	143,869	276,341	92,169	**607,722**	153,407	63,210	**216,617**	**824,339**
8/7/2009	63,145	137,571	248,158	90,240	**539,114**	167,996	63,947	**231,943**	**771,057**
8/8/2009	169,499	130,424	213,630	90,391	**603,944**	148,206	63,342	**211,548**	**815,492**
8/9/2009	94,839	121,017	214,196	73,102	**503,154**	154,330	62,495	**216,825**	**719,979**
8/10/2009	120,510	115,609	229,267	71,363	**536,749**	141,226	61,496	**202,722**	**739,471**
8/11/2009	117,119	101,031	204,274	68,332	**490,756**	140,775	63,610	**204,385**	**695,141**
8/12/2009	81,092	97,921	200,260	65,179	**444,452**	168,324	63,237	**231,561**	**676,013**
8/13/2009	44,344	88,626	186,776	58,654	**378,400**	149,932	58,917	**208,849**	**587,249**
8/14/2009	10,724	74,598	181,830	55,846	**322,998**	196,431	54,016	**250,447**	**573,445**
8/15/2009	17,801	62,021	173,553	47,360	**300,735**	180,958	52,319	**233,277**	**534,012**
8/16/2009	17,801	47,344	129,534	40,108	**234,787**	155,833	45,031	**200,864**	**435,651**
Total*	2,159,574	2,279,132	4,394,116	1,346,327	**10,179,149**	2,966,197	1,080,935	**4,047,132**	**14,226,281**

*Due to the effects of cumulative rounding, the totals shown on this table may be slightly different from the totals shown on other tables for this fire.