



A NATIONAL COHESIVE WILDLAND FIRE MANAGEMENT STRATEGY



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Rural firefighters provide structure protection during the Castle Rock fire in Idaho. Credit: NIFC, Kari Greer

EXECUTIVE SUMMARY

Addressing wildfire is not simply a fire management, fire operations, or wildland-urban interface problem — it is a larger, more complex land management and societal issue. The vision for the next century is to:

Safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.

Three primary factors have been identified as presenting the greatest challenges and the greatest opportunities for making a positive difference in addressing the wildland fire problems to achieve this vision. They are:

- **Restoring and maintaining resilient landscapes.** The strategy must recognize the current lack of ecosystem health and variability of this issue from geographic area to geographic area. Because landscape conditions and needs vary depending on local climate and fuel conditions, among other elements, the strategy will address landscapes on a regional and sub-regional scale.
- **Creating fire-adapted communities.** The strategy will offer options and opportunities to engage communities and work with them to become more resistant to wildfire threats.
- **Responding to Wildfires.** This element considers the full spectrum of fire management activities and recognizes the differences in missions among local, state, tribal and Federal agencies. The strategy offers collaboratively developed methodologies to move forward.

Three Primary Factors

Restoring and Maintaining Resilient Landscapes, Creating Fire-Adapted Communities and Responding to Wildfires



The Cohesive Strategy is defined by three phases. This phased approach allows stakeholders to both systematically and thoroughly develop a dynamic approach to planning for, responding to, and recovering from a wildland fire incident. The three phases include:

- **Phase I: National Cohesive Wildland Fire Management Strategy**
- **Phase II: Development of Regional Strategies and Assessments**
- **Phase III: National Trade-Off Analysis and Execution**

A cohesive strategy must commit to this shared national vision for present and future wildland fire and land management activities in the United States. It must build on the foundation of other efforts to establish direction for wildland fire management in America — the 1995 Federal Wildland Fire Policy and Program Review; the documents that comprised the National Fire Plan; *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: A 10-Year Strategy*; both editions of the Quadrennial Fire Review; *Mutual Expectations for Preparedness and Suppression in the Interface*; *A Call to Action*; and *Wildland Fire Protection and Response in the United States, The Responsibilities, Authorities, and Roles of Federal, State, Local and Tribal Governments*.

The past two decades have seen a rapid escalation of severe fire behavior, home and property losses, higher costs, increased threats to communities and worsening conditions on the land. These trends call for a broad-based, collaborative and cohesive response to better address the mounting challenges. Congress, the fire community, and the public have recognized a need for a new strategy, a new path forward and perhaps, a new way of thinking about wildland fire, recognizing a one-size-fits-all approach does not work across the Nation.

The challenges of fire management are formidable and growing more complex. The Nation has diverse landscapes, demographics, and social values; and because of this, a national strategy must address these differences. It will take a united, comprehensive effort to successfully address these issues.

The key to a cohesive strategy is its inclusiveness. A national strategy must be just that — one that has applicability and relevance across the board from the small, rural fire department in Maine, to a large city in California, to a state forestry department in North Carolina or a tribal community in the Midwest, as well as to the Federal agencies. Simply including all stakeholders is not enough. A strategy, shaped by a shared vision, requires building new relationships among those stakeholders. Skepticism and issues of trust must be recognized and overcome; all voices must be acknowledged and heard.

The Federal Land Assistance, Management and Enhancement Act of 2009 (the FLAME Act) was signed by the President in November 2009. The Act states, in part, “Not later than one year after the date of the enactment, the Secretary of the Interior and Secretary of Agriculture shall submit to Congress a report that contains a cohesive wildfire management strategy.” The FLAME Act directs that a cohesive strategy be developed addressing seven specific topic areas ranging from how best to allocate fire budgets at the Federal level to assessing risk to communities, and prioritizing hazardous fuels project funds. The FLAME Act is the catalyst for bringing fire leadership at all levels together and prompting a new approach to how wildland fire is managed. This new approach will guide the development of a national cohesive strategy that paves the way for developing a national wildland fire management policy.

PART 1:

NATIONAL CHALLENGES - MANAGING WILDFIRE ON THE NATIONAL LANDSCAPE

Wildland fire management response in the United States has evolved into an increasingly complex and multifaceted system. Climate change, fuels management, expanding wildland-urban interface and associated infrastructure, budgets, along with mission differences are some of the challenges facing wildland fire managers today. The National Cohesive Wildland Fire Management Strategy seeks to ensure that the values and concerns of the public and all governments are accurately understood and reflected. This demands a more comprehensive understanding of the diverse perspectives that underlie this situation – encompassing both the social/human and science dimensions.

Managers and natural resource experts recognize that the creation of a truly national cohesive strategy will include not only the seven elements identified in the FLAME Act but must also envision a broader, overarching and comprehensive consideration of all lands and fire programs. Therein lies the primary challenges facing wildfire managers, land managers, and communities in developing a strategy that meets local, regional and national needs.

Wildfire knows no boundaries; it does not recognize jurisdictional responsibilities. A single wildfire often crosses private, county, state, tribal and Federal lands and threatens communities, infrastructure, economies, and valuable natural resources that affect citizens, landowners and fire managers across all landscapes. Significant issues facing all departments and agencies are the effects of climate change, fuels management, and protecting resource values. Yet, there are critical differences in agency/department cultures and missions, and funding levels across fire management entities creating national challenges for all.

National Challenges

Engaging the public. While building and landscaping codes can aid in reducing the risk to homes and communities, additional actions must be taken by individual property owners. One of the leading challenges fire managers face is engaging the public to a level where individuals and communities assume responsibility for making their own properties fire-resistant. Measures, taken prior to a wildfire occurrence, by property owners on their own properties, result in the most effective efforts in protecting homes and communities. A national cohesive strategy will build upon earlier efforts, as an effective means to engage the public.



Firefighters talk to a home owner in the wildland urban interface on a fire in Idaho. Credit: Kari Greer, NIFC.

More resilient landscapes in dynamic environments. Declining vegetative health across the national landscape has contributed to the increasing risk of catastrophic wildfire which threatens landscapes and communities. These factors — including weather variability, fire exclusion, spread of insects and diseases and non-native species, changing land use, fragmentation, and urbanization — pose a significant challenge to establishing and maintaining healthy, resilient landscapes and communities.

Roles and responsibilities. Managing the Nation's wildfires is a comprehensive undertaking. Taking initial action at the most local level, managing large complexes of wildfires threatening communities, infrastructure and valuable natural resources, and all actions in between, are responsibilities of the Nation's fire community. A workable strategy must include and define the varying roles and responsibilities of fire managers at all levels and determine how those levels blend together to achieve the national goal of cohesive wildfire management.

Agency and mission differences. A local fire department's primary mission may be structural in nature, but its mission often includes initial attack on wildfire ignitions within its jurisdiction. State forestry agencies are bound to their mission of suppressing all fires threatening state and private timber and other resources. Federal agencies have a broader mission on public land and may employ alternative fire management strategies. Federal agencies also have a special trust obligation to Native Americans, their land and reserved rights.

An effective cohesive strategy must guide all organizations to recognize and accept each others' management differences and promote a more cohesive response to the wildfire management challenges across all jurisdictions.

Building on past success and shared understanding. The Nation's wildland fire community has greatly evolved since the days when firefighting resources were not shared, and fire crews would not cross jurisdictional boundaries to suppress a fire. Gone, too, are the days when Federal and state or local firefighters had no capability to communicate with each other on the fire line. While great strides have been made in collaboration and cooperation, there continues to be differences of perspective and associated tensions which must be addressed and resolved in order for a cohesive strategy to be effective.

Shared Assumptions

In spite of differences in culture, responsibilities, missions, funding and other elements of their respective fire programs, fire managers, at all levels, agree there are commonalities to be recognized in a national cohesive strategy. Addressing wildfire is not simply a fire management, fire operations or wildland-urban interface problem – it is a much larger, more complex land management and societal issue.

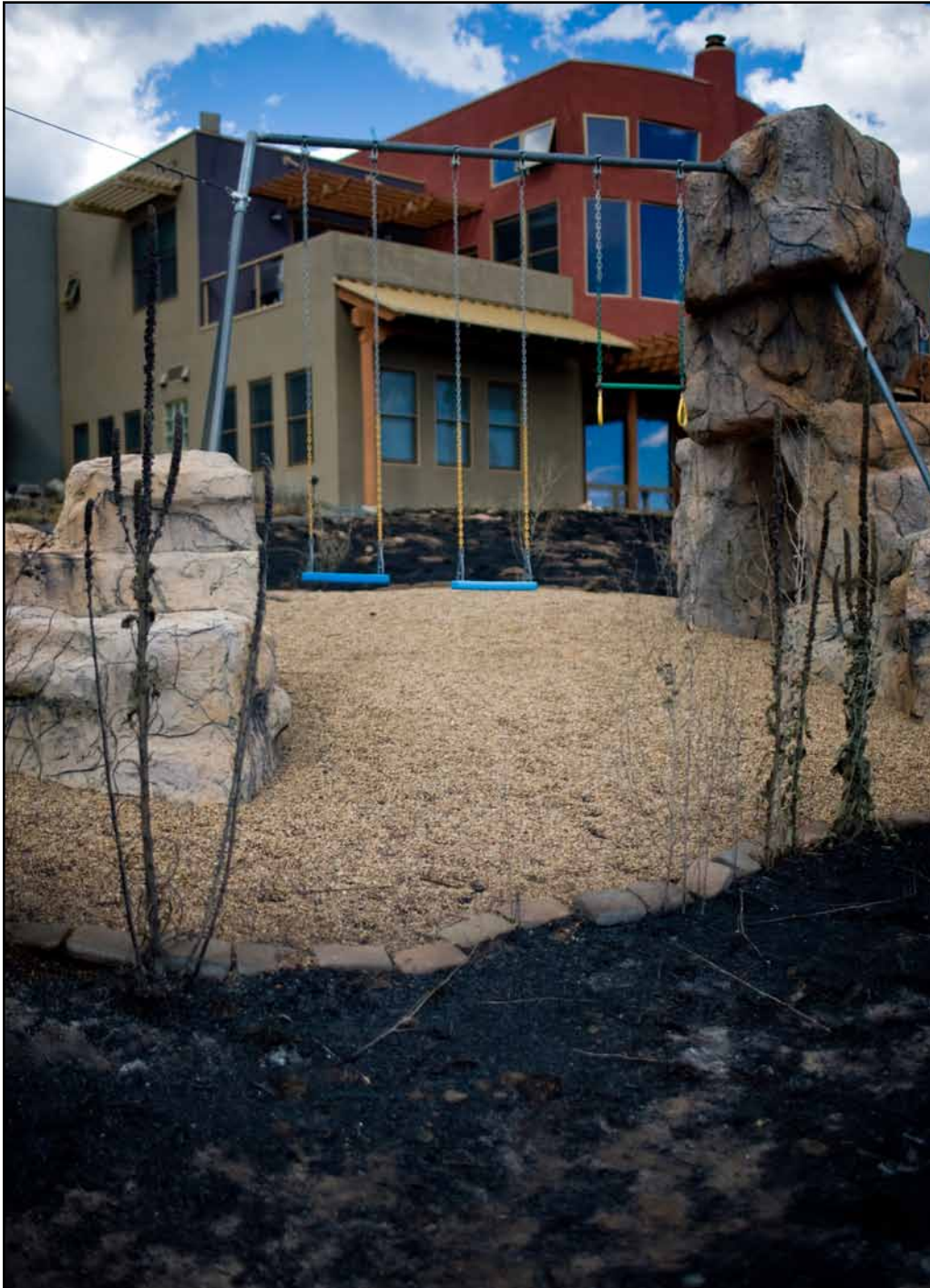
Insufficient active management and the need for a better understanding of fire's natural role in landscape health must be reflected in a cohesive strategy as a trigger for change. There are social and regulatory challenges to the active management of landscapes and biomass utilization. Because of fire's impact on air quality and water resources, and on commodity and community values, there are regulatory and social constraints on its use and management.

A national cohesive strategy must recognize the differences and tensions that exist among the partners and stakeholders and why those differences exist (e.g., different priorities, planning processes, legal mandates, values and resources) and seek to resolve them. It must build stronger relationships based on the successes of intergovernmental agreements for mutual response; incorporate cost and data sharing; include community protection planning (Community Wildfire Protection Plans or their equivalent), regional fire risk assessments, State and Forest Resource Assessments and Strategies; and encourage increased use of partnerships, grants and other funding opportunities. Each of these tools can be used to build stronger collaborative processes and move toward shared understandings that resolve conflicts and enhance partnerships among multiple landowners across all lands and jurisdictions.



Firefighters watch a plume of smoke during a WUI fire. Credit: FWS.

To achieve workable solutions, a cohesive strategy must ensure the human dimension is accorded equal weight with the physical and ecological science dimensions of wildfire. A national strategy will recognize the differences among the diverse areas of the Country – and promote public acceptance and understanding – i.e., how people filter, receive, accept, embrace and take action before, during, and after wildfires. True ownership for a “national” strategy is the means to the transformational process envisioned for landscapes and communities.



This house is inside the perimeter of the Fourmile Canyon Fire near Boulder, Colorado, in the wildland-urban interface. The 7,000 acre fire claimed nearly 170 houses in the first days of the blaze. The owners properly prepared their land for the potential of wildfire, including building with fire resistant materials, and preparing defensible, fuel-minimized spaces in the areas surrounding their home. Credit: Matt Slaby, NIFC.

PART 2: GUIDING PRINCIPLES AND CORE VALUES

A component of building on success includes moving beyond organizationally specific sets of guidelines that direct Federal, state, tribal or local fire policies. The following guiding principles were crafted through discussions with Federal, state, tribal, and local governmental and non-governmental organizational representatives. The goal was to build an overarching set of principles that would apply to all stakeholders in the wildland fire management community – and would also reach across the different elements, from resilient landscapes and fire-adapted communities to wildfire response. In developing regional strategies, these guiding principles and core values must be considered:

- Reducing risk to firefighters and the public is the first priority in every fire management activity.
- Sound risk management is the foundation for all management activities.
- Actively manage the land to make it more resilient to disturbance, in accordance with management objectives.
- Improve and sustain both community and individual responsibilities to prepare for, respond to and recover from wildfire through capacity-building activities.
- Rigorous wildfire prevention programs are supported across all jurisdictions.
- Wildland fire, as an essential ecological process and natural change agent, may be incorporated into the planning process and wildfire response.
- Fire management decisions are based on the best available science, knowledge and experience, and used to evaluate risk versus gain.
- Federal agencies, local, state, tribal governments support one another with wildfire response, including engagement in collaborative planning and the decision-making processes that take into account all lands and recognize the interdependence and statutory responsibilities among jurisdictions.
- Where land and resource management objectives differ, prudent and safe actions must be taken through collaborative fire planning and suppression response to keep unwanted wildfires from spreading to adjacent jurisdictions.
- Safe aggressive initial attack is often the best suppression strategy to keep unwanted wildfires small and costs down.
- Fire management programs and activities are economically viable and commensurate with values to be protected, land and resource management objectives, and social and environmental quality considerations.



The West Cinder prescribed fire in Idaho burned cheat grass and tumble mustard.

Credit: Kari Greer, NIFC.

PART 3: NATIONAL GOALS AND PERFORMANCE MEASURES

Wildfire crosses and affects all lands and resources regardless of jurisdiction and ownership. Each responding organization has a role in working together to protect lives, property and resources. Concise, mutually accepted goals and guiding principles are the foundation of a cohesive strategy. Clear accountability will ultimately promote transparency and aid oversight during the implementation phase. These overarching, broad goals and performance measures will be used as a foundation as regional tasks and actions and performance measures are developed in Phase II. Measurement of risk will be the common thread. Probability and consequences will be determined by region to inform this risk calculation.

Restore and Maintain Landscapes:

GOAL: *Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.*

Outcome-based Performance Measure:

- Risk to landscapes is diminished.

National output-based metrics, in support of the national measure, will center on risk to ecosystems at landscape scales.

Fire Adapted Communities:

GOAL: *Human populations and infrastructure can withstand a wildfire without loss of life and property.*

Outcome-based Performance Measure:

- Risk of wildfire impacts to communities is diminished.
- Individuals and communities accept and act upon their responsibility to prepare their properties for wildfire.
- Jurisdictions assess level of risk and establish roles and responsibilities for mitigating both the threat and the consequences of wildfire.
- Effectiveness of mitigation activities is monitored, collected and shared.

National output-based metrics will include indicators relevant to communities with mitigation plans and planned or completed treatments.

Wildfire Response:

GOAL: *All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.*

Outcome-based Performance Measure:

- Injuries and loss of life to the public and firefighters are diminished.
- Response to shared-jurisdiction wildfire is efficient and effective.
- Pre-fire multi-jurisdictional planning occurs.

National output-based metrics will reflect trends in changing risk to support the national measure. Indicators will include pre-season agreements and annual operating plans, integrated wildfire response scenarios, and shared training. Risk exposure to firefighters will be based on a balanced consideration of values protected and the probability of success.

Monitoring and Evaluation

Understandable, verifiable metrics will be developed in Phase II and Phase III to assess outcomes, ensure transparency, and provide oversight to the three primary factors of the Cohesive Strategy – restoring and maintaining landscapes, achieving fire-adapted communities, and responding to wildfire. Mechanisms for monitoring, evaluating, acquiring feedback, and sharing lessons-learned will be used to enable and encourage more timely adaptive management of the approaches and activities identified during the implementation phase of this strategy. Monitoring and evaluation of strategies and their effectiveness will be essential to the long-term success of a national cohesive strategy. Monitoring metrics will be developed to address trends over time.



A prescribed fire in Palm Beach County, Florida, helped to reduce the threat of wildfire for the surrounding community and improve wildlife habitat.

PART 4: GOVERNANCE

The Cohesive Strategy is designed to account for many of the needs, challenges, opportunities, and issues for all wildfire organizations, at all levels, across the Country. The Cohesive Strategy is dynamic and responsive to changes in the wildland fire community and environment. The FLAME Act requires that the Cohesive Strategy be revised at least every 5 years to consider changes with respect to landscape, vegetation, climate, and weather. The next two phases will address regional and local issues, with full implementation planned. For those reasons alone, the need for the Cohesive Strategy governance will continue.

Overall Governance of the Cohesive Strategy

The Secretaries of the United States Department of Agriculture (USDA) and the Department of the Interior (DOI) ultimately govern the development and implementation of the Cohesive Strategy; Congress exercises oversight. The Secretaries delegated the responsibility of overseeing development of the Cohesive Strategy to the Wildland Fire Leadership Council (WFLC). The WFLC is an intergovernmental council of Federal, state, tribal, county, local and municipal government officials convened by the Secretaries of the Interior, Agriculture, and Homeland Security to ensure consistent implementation of wildland fire policies, goals and management activities. The WFLC will remain as the body with oversight and decision-making authority through all phases of the cohesive strategy process. For a list of WFLC members, see Appendix E.

Future Governance

The WFLC designated the Wildland Fire Executive Council (WFEC) to oversee implementation of the Cohesive Strategy. The WFEC's organizational structure closely mirrors that of WFLC; thus, the same broad representation of local, state, tribal and Federal organizations remains intact. As Phase II of the Cohesive Strategy begins, regional strategy committees will be established. Local and regional plans and direction will take form during Phase II. Regions may elect to establish sub-regions to ensure inclusivity. The delegation of responsibility and authority for the Cohesive Strategy ensures a voice in governance at all levels and fire jurisdictions. For a list of WFEC members, see Appendix H.

Regional Strategy Committees

Regional Strategy Committees will include members from the DOI agencies, USDA Forest Service (Forest Service), tribes, state foresters, and representatives of the following elected officials: a governor, county commissioner, and mayor. Additional members may be added to the regional strategy committees as the committees see fit. One strategy committee will be established for each region. The regional strategy committee will be responsible for the identification of appropriate analysis areas. The regional committees will utilize expertise and information from existing entities within the region—scientists, traditional ecological knowledge sources, land managers, and other experts in wildland management, when conducting analyses for these areas.



A member of the Jackson hotshot crew cuts through thick brush while working on a hazardous fuels reduction project in Florida. Credit: BLM.

PART 5:
PHASE II: DEVELOPMENT OF REGIONAL STRATEGIES AND ASSESSMENTS
PHASE III: NATIONAL TRADE-OFF ANALYSIS AND EXECUTION

The Cohesive Strategy must reconcile concerns about wildfire risk, values at risk, and appropriate response to wildfire at different temporal and geographic scales. There is a need to balance a uniform evaluation of wildfire risk across the Nation, while ensuring that local and regional concerns and values are neither compromised nor overlooked. The full development of a national cohesive strategy will include a number of regional strategies supported by local and regional priorities, which may vary depending on local and regional concerns.

Wildfire Risk Assessment Process

A science-based framework will allow for systematic evaluation of a range of alternative future scenarios and land management options at national, regional, sub-regional and local scales. The wildfire risk assessment process provides a template that allows wildfire risk maps to link the probability of fire and fire intensity with potential resource benefits and loss of resources. The assessment process will be temporally scalable by including short-term versus long-term trade-off analyses. The process also will be geographically scalable by using nationally consistent data for coarse-scale analysis and refining data as the national template is adapted at regional and sub-regional assessment levels. The analyses results can be used at the national level by policy-makers and at regional and local scales by planners and managers to prioritize projects and investments to reduce wildfire risk. The process can be used to weigh management options within the context of land and resource management plans, collaborative frameworks, community protection plans, and other landscape planning efforts. The risk assessment process is more fully explored in Appendix A – *A Comparative Risk Assessment*.

Regional Strategies and Assessments

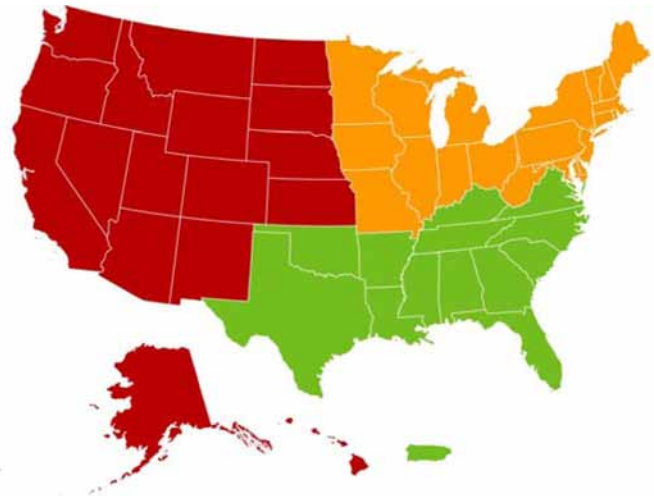
Regions

Three major regions of the Country have been identified—the Northeast, Southeast, and West. The Regional Strategy Committee will rely on information for all lands that is readily available to conduct wildfire risk analyses. These analyses will be informed by State Forest Resource Assessments and Strategies, Regional Wildfire Risk Assessments, Fire Program Analysis (FPA), resource and land management plans, and the Ecosystem Management Decision System (EMDS). Each region will use nationally consistent performance measures that translate to regional performance metrics.

Each region will identify strategies that consist of a portfolio of activities that address social and environmental values, risks and investments and will document progress and accomplishments. This information will identify the total multi-jurisdictional effort in meeting stated goals.

Regional strategies, which include the identification of barriers to the efficiency and effectiveness of the activities, will be used to inform a national trade-off analysis and identify the most effective allocation of funds. Regional Strategy Committees may delineate sub-regional areas for finer-scale analyses to inform priorities. Analyses at national, regional, sub-regional and local levels will be used to refine subsequent analyses at all three levels.

Figure 1. In Phase II, three regions have been identified by WFLC — Northeast, Southeast, and West.



The National Cohesive Wildland Fire Management Strategy intends to consistently address risks at multiple scales. There are analysis cycles that occur at the national, regional (and sub-regional), and local levels. It is important that linkages exist between each level from a top-down as well as a bottom-up perspective. Local risks are managed through local risk analyses/decision-making; regional risks are managed through regional risk analyses/decision-making; and national risks are managed through national risk analyses/decision-making. National goals and priorities influence regional goals and priorities, and national and regional goals and priorities influence local goals and priorities. Likewise, local goals and priorities influence regional/national goals and priorities. Information is shared in an upward way to inform higher level analyses and decision-making. Local values and risks influence regional and national values and risks. Likewise, national values and risks influence regional and local values and risks. The risk management framework of the National Cohesive Wildland Fire Management Strategy is designed to consistently address these elements.



Wildfire burns in the Guadalupe Mountains National Park in Texas. Credit: Fred Armstrong

Comparing National and Regional Strategies

As the National Cohesive Wildland Fire Management Strategy evolves, regional strategies will be developed that include different investment levels and mixes of options for reducing wildfire risk. These differences would reflect varying levels of emphasis on the major goals, in addition to recognizing fiscal and practical constraints. The Cohesive Strategy will include selected strategies from each region.

A comparative risk assessment is one method for rigorously comparing differences among strategic alternatives. Risk assessment is a mature scientific approach to quantifying risk. Comparative risk assessment extends the analysis to include the decision space available to managers and stakeholders to allow them to explore trade-offs among alternative courses of action. Taking this additional step requires understanding risk tolerance.

Assembling the various options into regional alternatives and then choosing among those alternatives to build a national strategy is an exercise in social choice and collaborative decision-making. Formal analytical methods exist that can help structure the decision process and make trade-offs transparent. These methods begin with clear articulation of goals and objectives and identification of alternatives, which will occur through a collaborative process involving the full spectrum of stakeholders. Quantitative analysis of each of the proposed alternatives would fall to regional analysis teams that would include university scientists and professional consultants in addition to Government researchers and analysts.

Phase II: Development of Regional Strategies and Assessments

Regional strategies will be developed and analyzed using a collaborative process that cycles between analysis and engagement with stakeholders. The process will include the following steps:

- WFEF identifies the national science/analysis team;
- WFEF adopts guidance for Regional Strategy Committees;
- Regional Strategy Committees are identified and will develop an understanding of the governance/oversight roles.
- Each Regional Strategy Committee will include representatives identified and selected by WFEF;
- Regional analytical teams are identified.
- Timeframes for the following four steps will be determined by the Regional Strategy Committees:
 1. Define the analysis process. This will include identifying the information available; the analytical tools that can be employed; and who is available to engage in the analysis.
 2. Define and analyze initial alternatives. This will involve describing an initial set of broad alternatives, including understanding the goals of each alternative, the components that are needed for the analysis of each alternative and the bounds of the analysis and problem to be addressed. Analysis of these alternatives will help test the analytical methods,

and ultimately provide information that will be needed by the regional technical and stakeholder groups to help refine specific regional alternatives.

3. Collaboratively identify the regional alternatives. Relying on local and regional knowledge and insights, describe a small set of regional alternatives. This exercise draws from the understanding gained from analysis of the initial alternatives. These alternatives would be shared with and shaped by regional stakeholders.
 4. Analyze the regional alternatives and share the results with stakeholders. Update content based on regional feedback.
- Submit results of the regional analyses for national analysis.



Fire was used by the North Carolina Division of Forest Resources to reduce hazardous fuels during a prescribed burn project. Credit: Dan Smith, NASF.

Phase III: National Trade-Off Analysis and Execution

During Phase III, the following steps will occur:

- Conduct the national analysis. Develop a draft national summary of the regional alternatives. The summary will include a description of the decision space available, a description of the activities and priorities associated with the regional alternatives, and a description of the tradeoffs associated among the alternatives.
- Share the results of the national results and summarization with stakeholders.
- Update and conclude the analysis based on feedback from the stakeholders.
- Establish a 5 year review cycle to provide updates to Congress.

In Conclusion

The Cohesive Strategy envisioned by the WFLC builds on successes of the past while incorporating a new collaborative approach to managing a complex national problem — wildfire. This new approach includes all the partners involved in fire management and gives each a voice and a role in addressing a collective problem. Reducing the risk of wildfire to landscapes and communities and crafting more effective responses to wildfire are daunting challenges at the local, regional, and national levels.

Decisions concerning investment to manage wildfire risk across the landscape must consider a wide range of strategic issues. Programs to protect lives and property will compete for available resources over different geographical areas. Comparative benefits will be valued by long-term effectiveness at reducing risk. Considering the problem at multiple scales (local, regional, and national), provides the best method to evaluate the impact of those programs and to deliver the desired results.

The Cohesive Strategy takes into account the fact that there are unique needs and environmental differences across the Country. It does not take a national top-down approach. Instead, it divides the Country into three regions that can be further divided into analysis areas, each of which will create strategies for best addressing localized or regional wildfire problems. Risk assessments will be used to identify lands and communities with highest risk and determine the actions that will have the most impact. Within the three regions, tribal, state, regional, and local interests will be heard and considered before regional strategies are rolled up into a national strategy.

The cohesive strategy process outlined here is not an endpoint. It is a beginning. Goals and principles have been agreed to by national representatives of all the stakeholders. Now begins the hard work of bringing the stakeholders, landowners, homeowners, and natural resource and fire managers together to do the regional analyses, discuss priorities, and share the mantle of responsibility for minimizing wildfire risk. Tribes, states, counties, and communities must be full partners with fire managers in protecting homes and lives from wildfire.

Taking a proactive, collaborative approach to solving the Nation's wildfire problem and involving all stakeholders provides the best opportunity to restore and maintain landscapes, protect communities from wildfire and effectively respond to wildfires when they occur.

As cited in the 2009 *A Call to Action* formulated by fire managers across multiple jurisdictions and identified as a foundational document by WFLC, "Effective partnerships, with shared responsibility held by all stakeholders of the wildland fire problem, will create well-prepared, fire-adapted communities and healthy, resilient landscapes at the most efficient cost." This is a challenge of the National Cohesive Wildland Fire Management Strategy.

APPENDIX A: COMPARATIVE RISK ASSESSMENT

The National Cohesive Wildland Fire Management Strategy (National Cohesive Strategy) is a national strategy inclusive of all lands – applicable and relevant to local, state, tribal, and Federal entities. A key to the National Cohesive Strategy is its inclusiveness. The success of Phase II of the National Cohesive Strategy hinges on regional and national trade-off analyses with meaningful participation by diverse partners.

The following appendix, Comparative Risk Assessment Framework for Wildland Fire Management, describes possible approaches and methodologies for the analytical processes of Phase II. The primary purpose of the example is to demonstrate and test the framework and explore risk-based approaches. The regional and national analyses of Phase II are expected to utilize more comprehensive data than was possible in the current example. The expectation is that Phase II will rely on the best available information from local, regional, and national sources that can be consistently assembled. While this will surface data shortcomings, there is a commitment to continuously update the National Cohesive Strategy and improve the datasets used in the Comparative Risk Assessment.

A Comparative Risk Assessment Framework for Wildland Fire Management

I. Background

Major investments are being made throughout the United States in ongoing efforts to reduce human and ecological losses from catastrophic wildfire. It is becoming increasingly clear that landscape scale changes in vegetation structure and fuel loadings are needed to significantly alter wildfire behavior, reduce wildfire losses, and achieve longer term fire resiliency. The most efficient way to achieve these long-term landscape goals remains unclear, and there are different perceptions on the relative role and effectiveness of management activities versus natural and managed wildfire to reduce fuels.

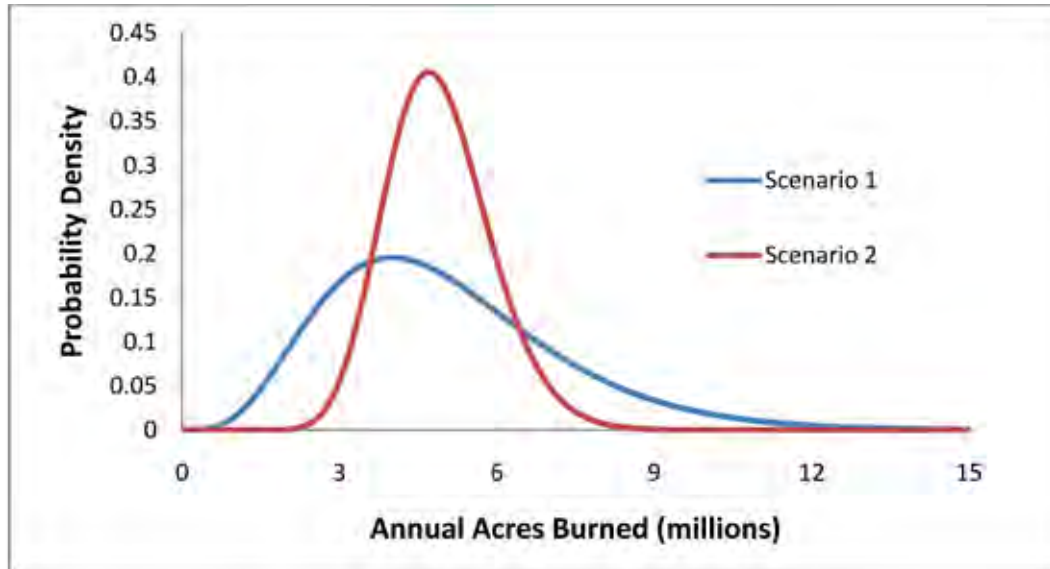
Risk is an inescapable component of living with wildfire. Whether one uses risk in the conventional sense of “something bad may happen” or a more precise definition such as the expected loss from an uncertain future event(s), the basic elements of uncertainty and loss are there. Following this basic reasoning, one can view the National Cohesive Strategy as a classic problem of *risk management*. That is, effective management requires understanding the nature of wildfire and its contributing factors, recognizing the consequences—good and bad—of fire, addressing uncertainty, and crafting plans that reduce the chances of catastrophic losses. Real-world constraints on funding, available resources, and administrative flexibility further require consideration of economic efficiency and practicality.

In order to help meet the challenges of the National Cohesive Strategy, the Science Panel proposes using comparative risk assessment as a rigorous basis for analyzing strategic alternatives (see complete report at <http://www.forestsandrangelands.gov>). Risk assessment is a long standing and mature scientific approach to quantifying risk; comparative risk assessment simply extends the analysis to include the decision space available to managers and stakeholders to allow them to explore the trade-offs between alternative courses of action. Taking this additional step requires understanding preferences and risk tolerance. Ultimately, choosing among available options demands clarity in management objectives, and where multiple objectives are present, understanding management priorities. A cornerstone of the National Cohesive Strategy will be regional strategies that address regional risks. A shared risk framework ensures consistency and comparability across goals, performance measures, methodologies, and data collection.

Recent developments in technology and decision support systems have improved the ability to assess, monitor, and respond to wildfire risk. For example, wildfire simulation models support tactical and strategic decisions related to reducing wildfire risk, and have been coupled with geospatial data on values to build risk-based decision support systems. The result has been a rapid advance in the application of risk analysis across a full range of wildfire management activities. Risk analyses are now being applied across the U.S. for a wide range of wildfire problems, including risk monitoring, strategic budget planning, wildland fire decision support systems, and fuel treatment planning.

Any rigorous approach to risk begins with a clear definition of the terminology. Herein, risk is defined as a composite measure of the probability of a set of possible outcomes and the consequences associated with each outcome. That is, risk is a two-dimensional measure that includes both the probability and magnitude of potential outcomes. For example, consider the two probability distributions shown in Figure 1, which represent the uncertainty in the number of acres burned annually under two scenarios. Both distributions have an average value of 5 million acres, but the wider spread in the curve tagged Scenario 1 suggests greater uncertainty in what the actual value in a given year will be. If the social or ecological consequences associated with each acre that burns increases with the total acres burning, then Scenario 2 would be preferable to Scenario 1, despite having the same expected value. Discerning such differences requires understanding the consequences of fire beyond simple summary statistics.

Figure 1. Quantifying risk as a probability distribution



Although the full probability distribution is preferred for many comparative risk assessments, reducing risk to a single index can aid risk comparisons across complex landscapes where the sheer numbers to consider can be overwhelming. One such index is the probabilistic expectation of net resource value change in response to fire. Mathematically, this is defined as:

$$E(NVC_j) = \sum_i p(f_i) RF_j(f_i)$$

where:

$E(NVC_j)$ expected net value change to resource j

$p(f_i)$ probability of a fire at intensity level i

$RF_j(f_i)$ response function for resource j as a function of fire intensity level i

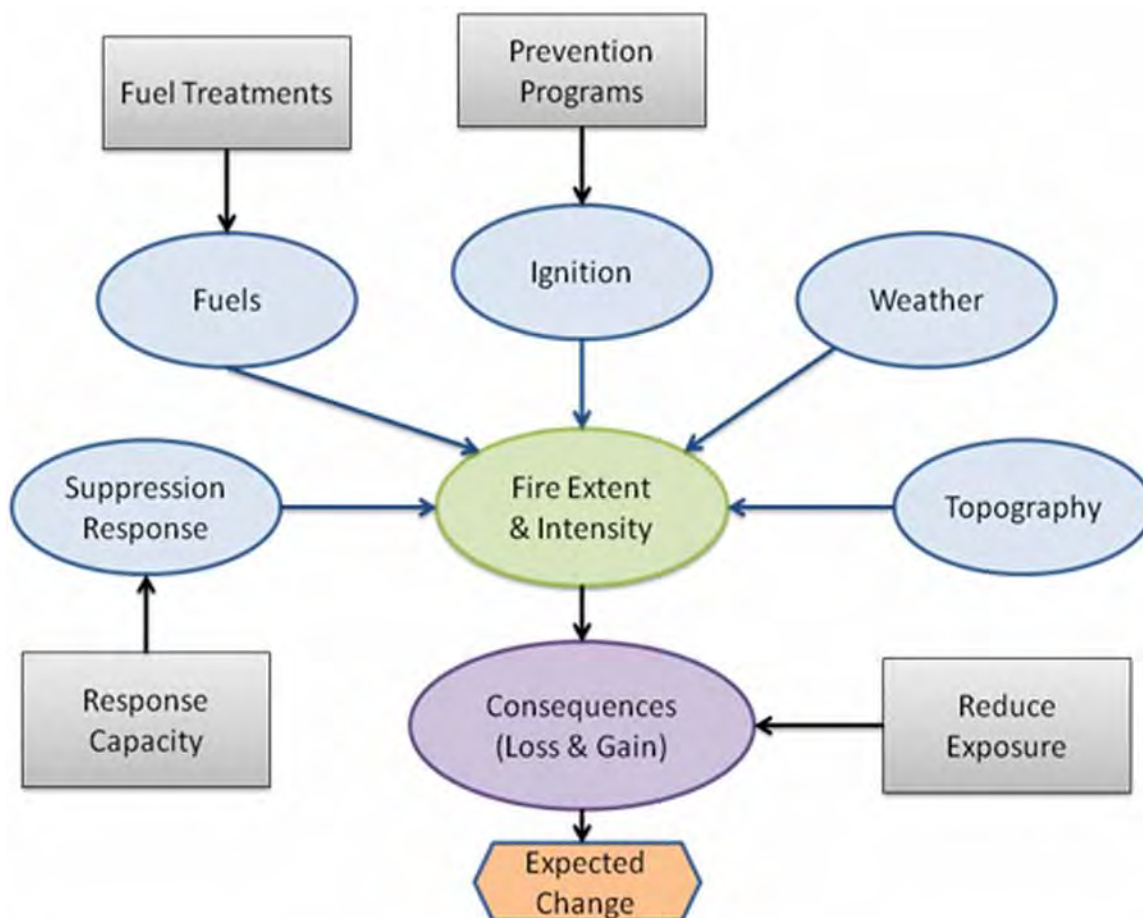
Thus, the expected NVC is the product of burn probability at a given fire intensity and the resulting change in resource value, summed over all possible fire intensities. The components required to generate spatially explicit wildfire risk indices are: 1) burn probability maps generated from wildfire simulation models, 2) spatially identified resources, and 3) response functions describing the impact of fire on the resource(s) in question.

Essential Elements for Analyzing Risk

One of the first steps in comparative risk assessment is developing a conceptual model that simplifies the problem into a set of basic components and provides a framework for discussing strategic options. For example, consider the hypothetical case of a single wildfire. Whether a wildfire ignites and how extensively and intensively it burns depends on the interactions of five factors: a source of ignition, available fuels, topography, weather, and suppression response. By itself, the fire is simply an event. It can be described by its location, intensity, duration, extent, or other characteristics, but it has no normative value—it is neither good nor bad. The consequences matter, however, whenever homes and other structures are involved, or when critical habitat for an endangered species will be rendered unsuitable for decades following the fire. Naturally, the extent of the loss of value depends on the extent and intensity of the fire and how many homes or acres of habitat are affected.

This simple model of risk can be completed by adding consequences (value changes) and management options available that might directly affect factors contributing to risk (**Figure 2**). For example, a fire prevention program could lessen the probability of human caused ignitions. Similarly, a fuels treatment program might change fire behavior and make it less damaging or easier to suppress. A third option might be to consider adding firefighting capacity to the local community or management unit so that wildfires are more often contained before they grow large and damaging. Finally, some consideration might be given to reducing the likelihood of a wildfire damaging homes or other structures by focusing on the immediate area around the home or near critical habitats. The intent in this option is not to change fire directly, but rather to lessen the consequences if it occurs.

Figure 2. A simple conceptual model of wildfire, its contributing factors, consequences, and management options.



The next step in comparative risk assessment is translating the conceptual model into a probabilistic model that can be used to generate quantitative estimates of risk, given alternative management choices as inputs. Such models must be parameterized and validated using rigorous statistical methods and checked against empirical data if they are to rise to the standard of high-quality risk assessment tools. Finding the appropriate balance among model complexity, data demands, and utility is a major challenge. The example analyses described in following sections suggest that current models and data are available to help meet this challenge, but more work is needed.

Balancing Regional and National Priorities

Developing an overarching national strategy invariably will involve tradeoffs between regional and national priorities. As the National Cohesive Strategy evolves, various regional strategies will be proposed that include different investment levels and mixes of options for reducing wildfire risk. These differences would reflect varying levels of emphasis on the major goals of the National Cohesive Strategy, in addition to recognizing fiscal and practical constraints. For example, each regional strategy could consist of a given funding level for each of the three key components of the National Cohesive Strategy— Landscapes, Fire Adapted Communities, and Wildfire Response. The National Cohesive Strategy will comprise selected strategies from each region.

Assembling the various options into regional alternatives and then choosing among those alternatives to build a national strategy is fundamentally an exercise in social choice and collaborative decision making. Formal analytical methods exist that can help structure the decision process and make trade-offs transparent. Consistency among the methods used in each region will help facilitate national comparisons. There is a tension between adopting a top-down approach and retaining analytical and decision flexibility at regional and local scales. The more disparate regional analyses are, the greater the difficulty of integrating analyses, maintaining and updating analyses over time, and comparing outputs over time to previous versions.

One of the primary challenges for both regional and national efforts is developing performance measures (i.e., assessment endpoints) that accurately represent accomplishments in risk reduction and integrate the diversity of regionally specific issues and management priorities. Regional analyses can provide more refined risk analysis than available at the national scale and clarify the relative priority of protecting potentially competing resource demands. However each region may identify alternative methods for considering risk to individual resources and consider different sets of values. Accommodating these differences—while maintaining the capacity for national comparison—requires careful attention to methods and data.

II. Probabilistic Assessment of Wildfire Risk: A National Example

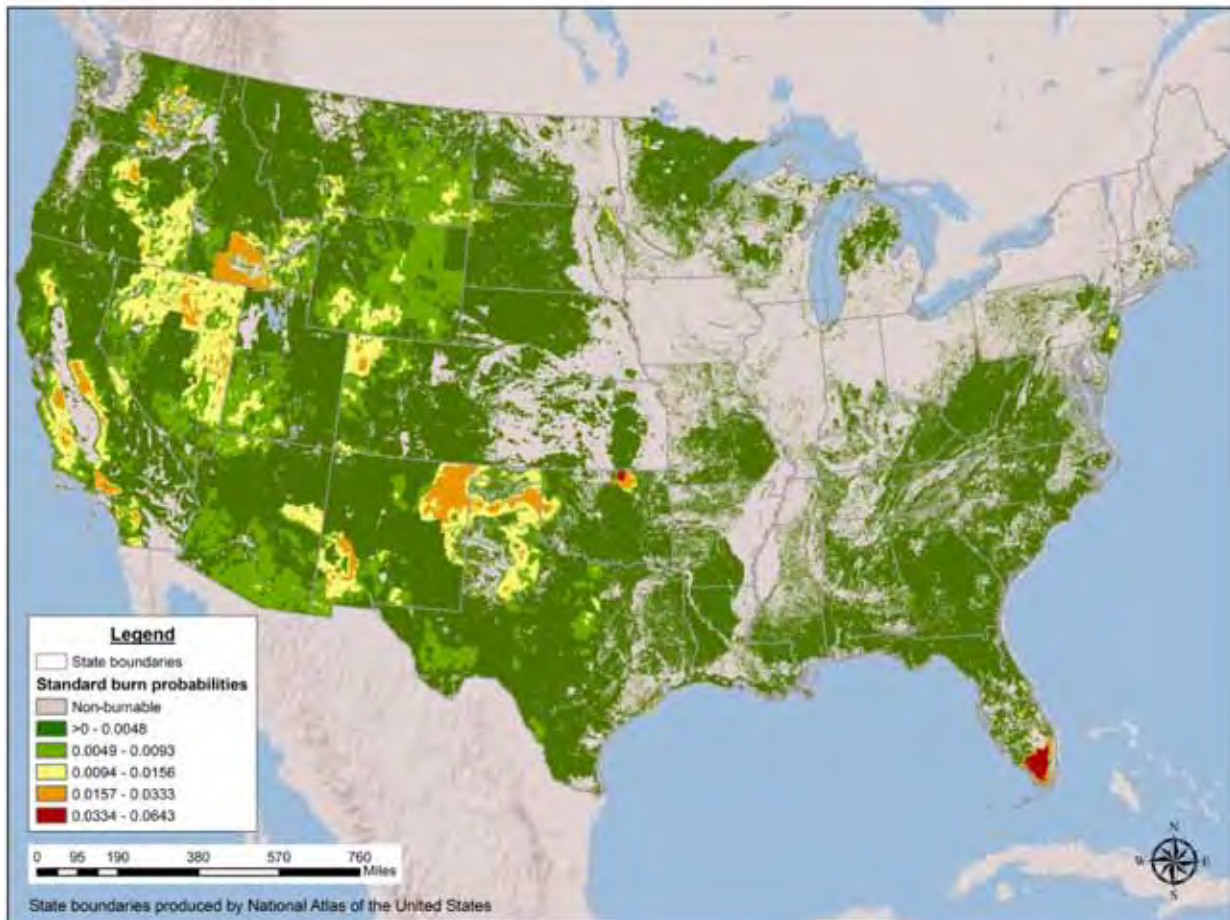
A recent publication, *Wildland Fire Risk and Hazard: Procedures for the First Approximation*, describes a baseline assessment framework from which to build national, regional, and sub-regional analyses. This national assessment provides an example of how wildfire risk can be assessed at the national level. It was completed to facilitate monitoring trends in wildfire risk over time, and to develop information useful in prioritizing fuels treatments and mitigation measures. The project employed a risk framework that included:

- Estimating spatially explicit fire probability and intensity through the use of a wildfire simulation model
- Characterizing important resource values and assets (for example, municipal watersheds, endangered species habitat, and where people live)
- Developing response functions to quantify how important resource values and assets change under varying levels of fire intensity
- Calculating expected NVC and summarizing by geographical areas

Seven broad categories of developed and natural resources were included in the assessment: populated areas, fire-adapted ecosystems, fire-susceptible species, energy infrastructure, recreation infrastructure, municipal watersheds, and air quality. These values were consolidated into a single measure using relative scoring criteria commonly used in problems involving multiple variables that are not directly comparable. It is recognized that the resources considered in this first approximation do not include all the resources deemed important to each region of the Country.

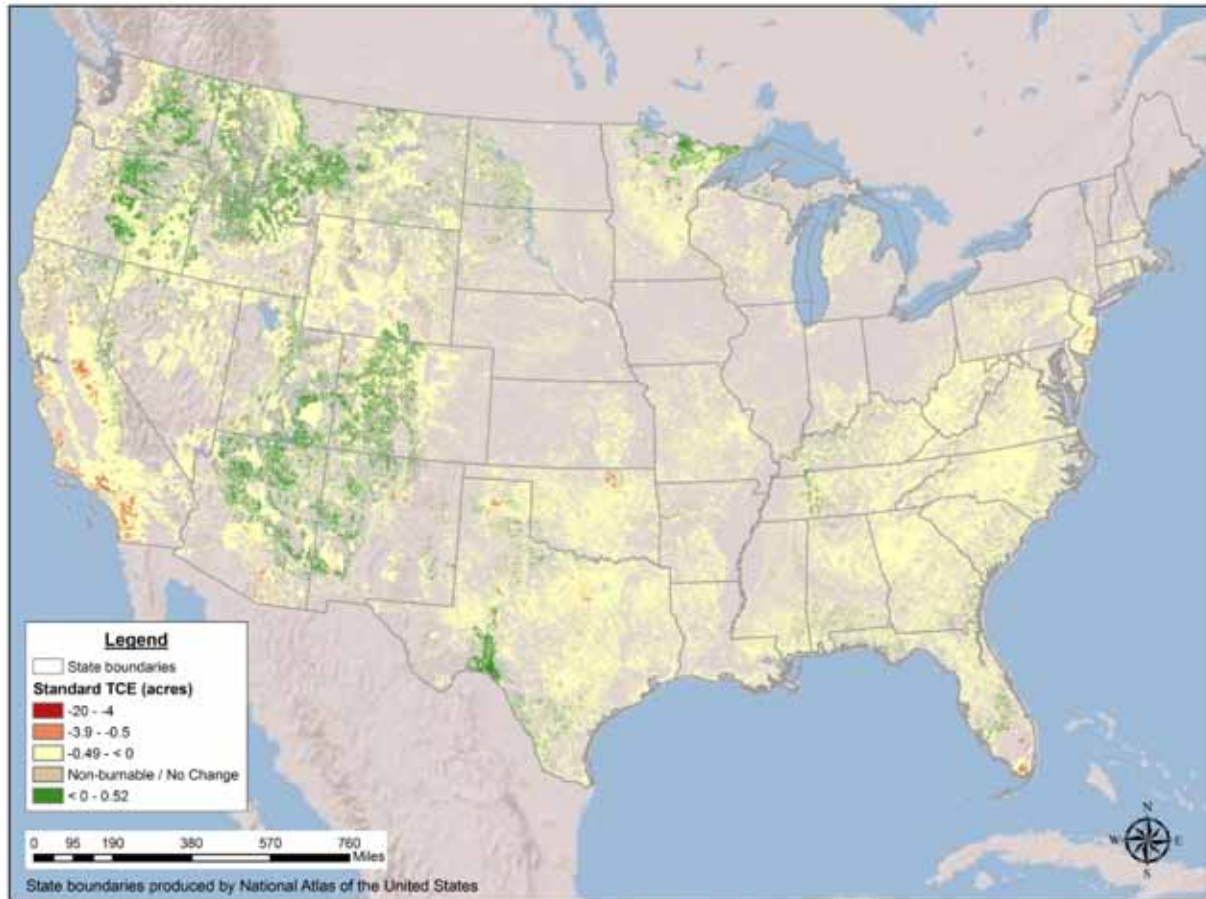
The national maps of burn probability and conditional fire intensities reveal important regional differences. First, burn probabilities are generally higher in the western half of the Country, with the notable exception of southern Florida (Figure 3). Fires often grow larger in the west because of the continuity of wildland vegetation. Second, flame lengths tend to also be greater in the west and along the edge of the east coast because of the potential for crown fire caused by conifer forest and fuel structure. Higher probabilities of low flame lengths predominate in the eastern half of the Country.

Figure 3. National map of burn probability generated using simulation modeling.



Similar regional patterns are apparent in the national risk map (Figure 4). Higher expected losses appear concentrated in southern Florida, southern California, and the along Sierra Nevada mountain range. Examining the factors that comprise risk helps identify why some regions have higher values than others. For example, southern Florida exhibits high burn probabilities and high conditional flame lengths, as well as fire-susceptible endangered species like the Cape Sable Seaside Sparrow. Southern California has moderately high burn probabilities and conditional flame lengths paired with high population density and other resource values exposed to fire. The risk map suggests the beneficial influence of wildfire to fire-adapted ecosystems throughout the interior Great Basin and Northern Rockies regions.

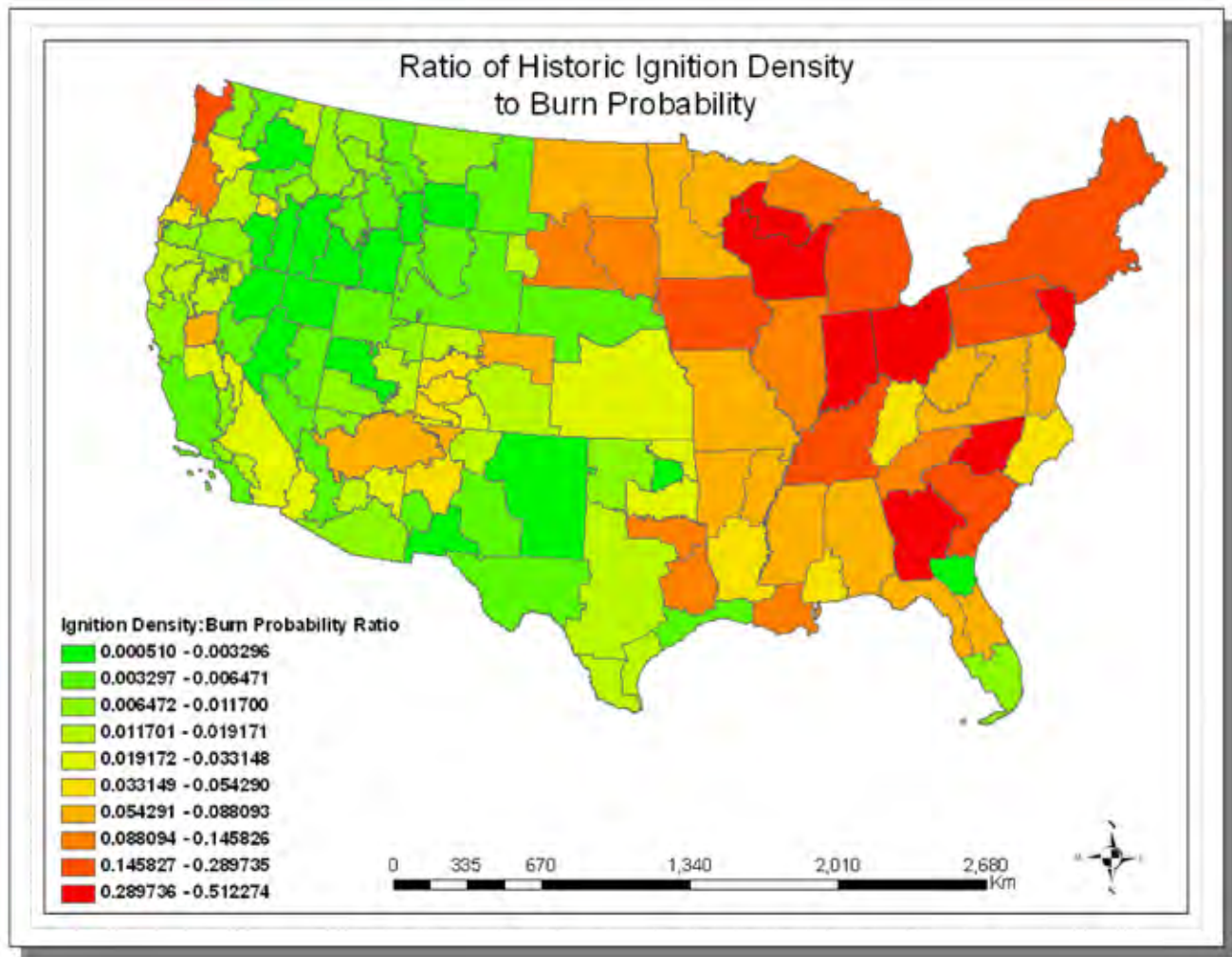
Figure 4. National map of wildfire risk as quantified by the total change equivalent (TCE), an area-based measure (acres per 18-acre pixel per year) of relative acres gained/lost due to wildfire.



Estimates of overall risk can be summarized by resource category and geographic area. In this analysis, populated areas contribute most to national wildfire risk (58 percent) followed by municipal watersheds (20 percent), fire susceptible species (13 percent), infrastructure (7 percent), air quality (2 percent) and recreation (.02 percent). Fire adapted ecosystems actually reduce overall risk by 1 percent, which demonstrates a net beneficial response to wildfire. Although benefits are observed across broad areas, their overall magnitude is quite modest relative to anticipated losses associated with populated areas and watersheds. Among geographical areas, California representing 30 percent of national wildfire risk, followed by the Southern Area (22 percent), Southwest (17 percent), Great Basin (10 percent), Rocky Mountain (10 percent), Northwest (5 percent), Northern Rockies (4 percent) and Eastern (3 percent).

The national risk maps also highlight an important distinction between wildfire risk and wildfire occurrence. While relevant to emergency fire response and firefighting infrastructure, ignition locations or densities depict only localized impacts from nearby ignitions and not from fire spread or area burned. This is because burn probability can be relatively high in areas with large fires, even though ignition probability is low. As fires grow large, they spread long distances and burn locations distal to the ignition. Figure 5 depicts the ratio of ignition density (#/ac/year) and burn probability from historical fire records. High values in Eastern areas and the Northwest coast imply high numbers of ignitions relative to the total area burned.

Figure 5. Ratio of ignition density (#/ac/yr) to burn probability from historical data (1980-2008). High values shown in red and orange indicate many ignitions relative to area burned.



III. Exploring Options for Reducing Risk

The discussions above focus on current levels of risk or simple conceptualizations of how natural factors and management actions affect risk. Broader management options that might be taken to affect those risks are implied, but have not been specifically analyzed. More complete analyses of regional and national investment strategies are expected as the National Cohesive Strategy progresses. In the interim, it is instructive to consider the types of options available, how they might be analyzed, and what available information might be relevant. The simple conceptual model in Figure 2 identified four basic options for affecting risk:

- Invest to prevent human caused ignitions
- Invest in fuel treatments
- Invest to build capacity in wildfire response
- Invest to protect values exposed to risk

We speak to each of these individually, but as will become readily apparent, the real work is in trying to understand how they might best be applied together.

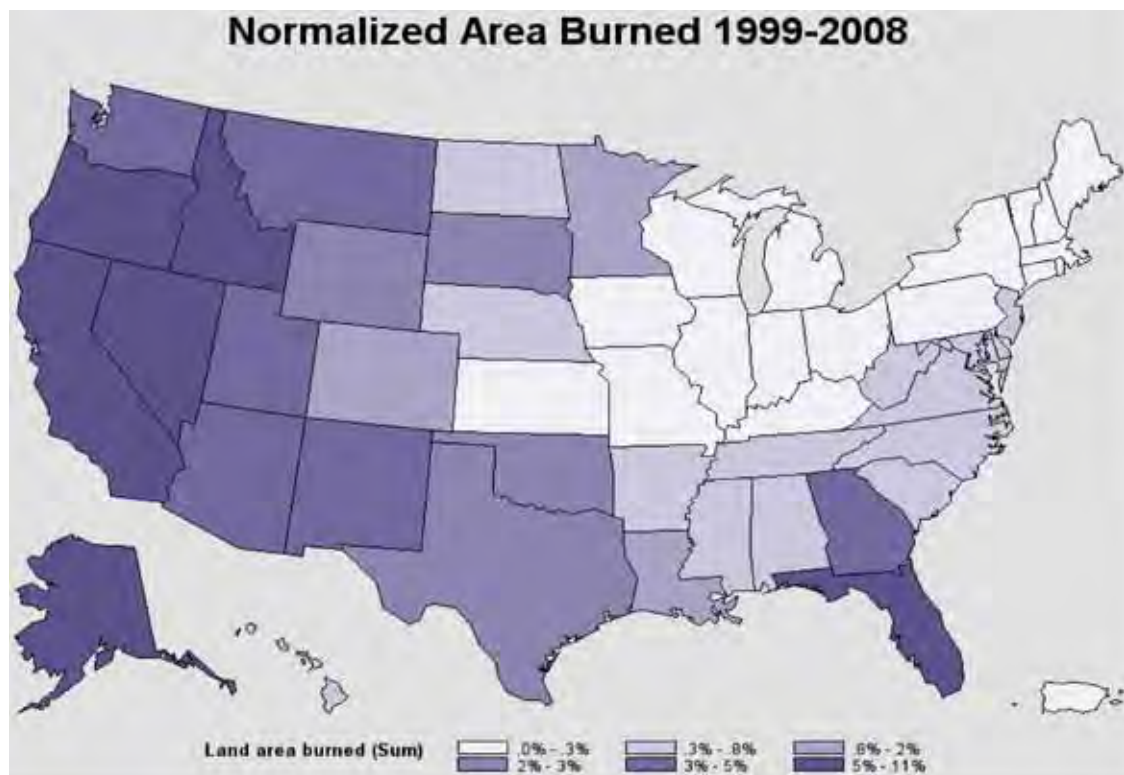
To understand how each option might play out, it's necessary to 1) establish a historical point of reference, 2) develop an analytical capacity to examine the relative effectiveness of each option, and 3) project conditions into the future. Fortunately, there are numerous completed and ongoing assessment and planning efforts that provide a good start on having the tools and information needed. For example, Fire Program Analysis (FPA) is an interagency effort that focuses on investment effectiveness. The analytical system designed and built to

support FPA models the effectiveness of fire prevention programs, investments in preparedness resources, and landscape fuel treatments. Effectiveness is evaluated by examining various performance measures tied to the probability and intensity of areas burning within the analysis area and the suppression costs associated with responding to wildfires. FPA is not the only modeling framework available to tackle these issues, but it is remarkable in its level of detail and extensive accounting and analysis features.

One of the more critical data sets used by FPA is the historical fire occurrence data compiled by Federal and state agencies. FPA uses these data to determine the location and cause of wildfire ignitions, as well as providing a basis for model calibration. The FPA data set has some known issues associated with data accuracy and completeness, especially regarding fires on non-Federal lands. Updated versions of the data set will correct some problems related to duplicate records and missing or inaccurate location information, but the updated data will likely still exclude some fires that occurred historically. The FPA records for fires occurring from 1999 to 2008 are used here for illustrative purposes, recognizing that improved and more comprehensive data may become available that could change the results.

As a point of reference, approximately 447,000 recorded wildfires occurred across the US between 1999 and 2008, burning nearly 70 million acres during this time period. Although the Southern geographic region led all regions with number of recorded wildfires (41 percent of total), most of the acreage burned in western states—over 18 million in Alaska alone—which tend to experience fewer, but larger fires on average. The 10-year historical average for the conterminous 48 states is close to the roughly 5 million acres per year of simulated wildfires used to generate the burn probability map shown above in Figure 3. Dividing the area burned in a 10-year period by the land area of each state produces an area-adjusted map of historical burning that corresponds well to the simulated burn probability map (Figure 6).

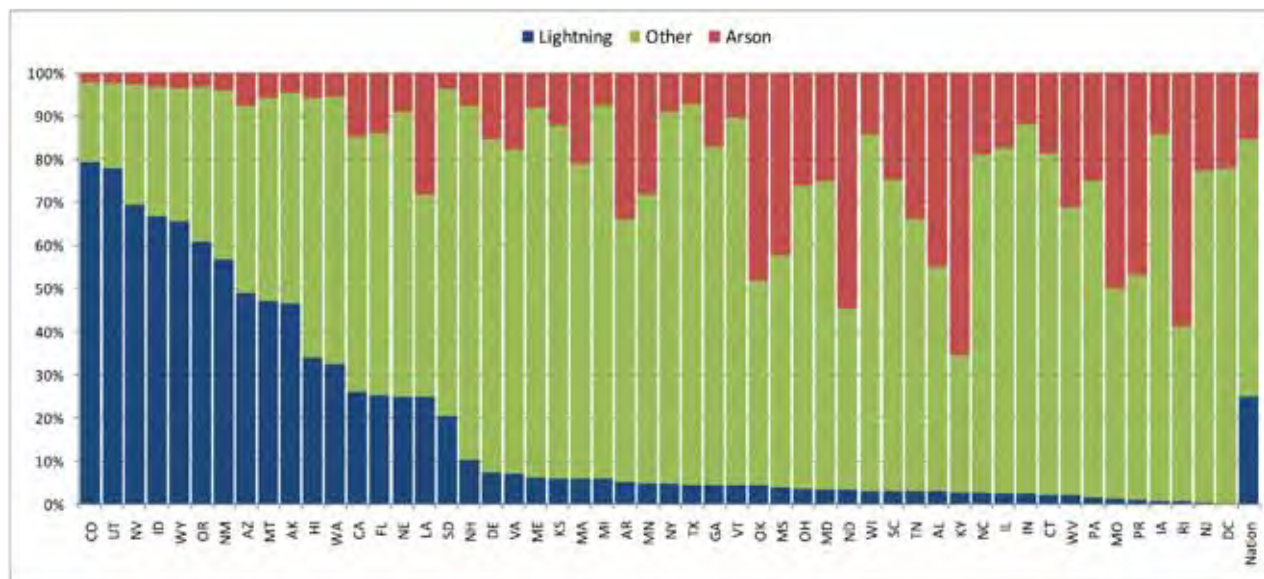
Figure 6. Cumulative area burned in each state from 1999-2008. Areas are normalized by dividing the area burned by the total land area in each state.



Option 1. Invest to Prevent Human Caused Ignitions

There is an old adage that the best way to stop a wildfire is to make sure it never starts. Wildfire prevention programs form an important component of any comprehensive wildfire management strategy. Ranging from the familiar Smokey the Bear® public education campaign to focused law enforcement, prevention efforts target those sources of human ignitions that can be avoided, including arson, debris burning, campfires, smoking, off-road vehicle use, and others. The degree to which human-caused ignitions contribute to wildfire is substantial. Nationwide, human ignitions (everything except lightning) accounted for nearly 75 percent of all wildfires starts, yet only 30 percent of the acreage burned. This disparity is due to geographical differences in wildfires; the western states experience larger fires dominated by lightning ignitions, while smaller wildfires in most eastern states are human caused (Figure 7).

Figure 7. Historical distribution of reported cause of wildfire ignitions by state (1999-2008)



Despite a long and storied history of fire prevention programs in the United States, scholarly analysis of the effectiveness of these programs is scarce. A recent article by Prestemon and others (2010) is a notable exception, who remark “although a common belief is that wildfire prevention education is worthwhile, there is a striking absence of studies documenting its effectiveness.” One of the more commonly used tools for estimating the effects of prevention programs is the Risk Assessment and Mitigation Strategies (RAMS) model, which was developed in the mid 1990’s using expert opinion. The RAMS model uses a combination of effectiveness factors and preventability factors to calculate the expected reduction in human ignitions given a prescribed mix of program elements such as patrols, signs, law enforcement, and public contact. The degree to which fire can be prevented varies by specific cause. The FPA incorporates RAMS in its suite of models and caps the preventability levels by cause. For example, no more than 7 percent of arson fires can be prevented within FPA, while 16 percent of fires started by debris burning and children can be prevented.

For illustrative purposes, the maximum preventability factors and historical fire information from FPA were used to calculate the upper limit for expected change in ignitions and area burned. Nationwide, an estimated 9.4 percent of the reported ignitions from 1999 to 2008 could have been prevented, which would have reduced the expected acres burned by 3.4 percent. The differences among states are dramatic, again, depending on whether fires are predominately human-caused. Normalized by land area within each state, the greatest gains in terms of ignitions per square mile are found in high-fire-frequency states such as Georgia, New Jersey, South Carolina, and Florida. In terms of relative change in the number of ignitions, many eastern states exceed the national average, while western states dominated by lightning-caused ignitions show relatively small benefits. Further analyses at the county level would show similar variation among counties within many states such as California with a mix of urban and wildland areas.

A comparison of these national results with the empirical results of Prestemon and others (2010) from Florida suggests that the limits on preventability imposed by RAMS may seriously underestimate the benefit of prevention programs in some areas. Using a sophisticated empirical model, Prestemon and others show that increased investment in wildlife prevention education (WPE) could result in reductions in preventable ignitions upwards of 80 percent, with associated reductions in acres burned a more modest 10 percent or less. Prestemon and others go further in their analysis, incorporating estimates of change in net value similar to the process described above to estimate that the marginal benefits of averted wildfire damages are 35 times the investment in WPE in Florida; reduced suppression costs alone account for 15 percent of the estimated benefit.

Option 2. Invest in Fuel Treatments

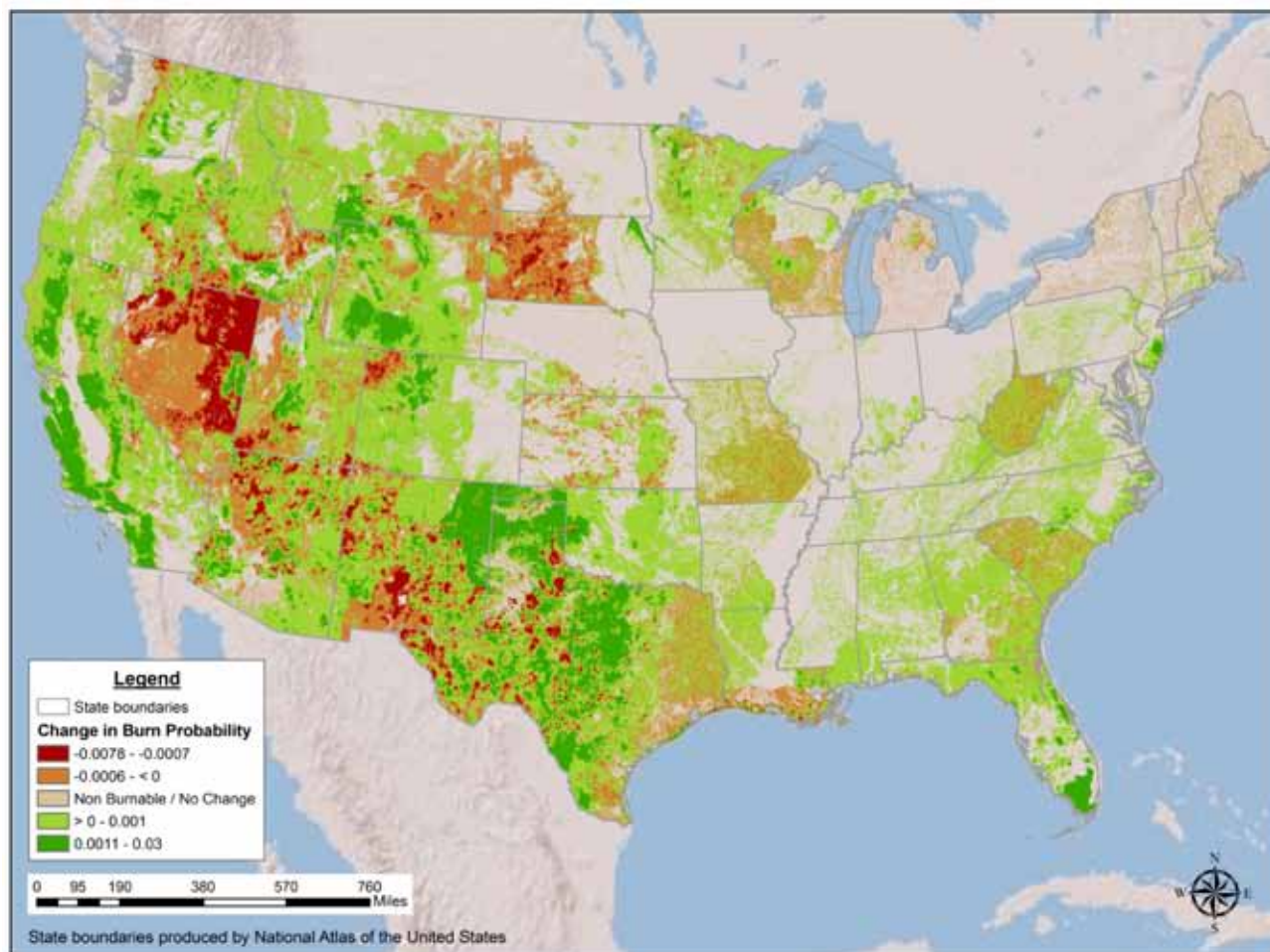
Considerable research has been conducted on landscape fuel treatment design, especially the spatial arrangement of treatments to achieve optimum reduction in fire spread and intensity. Viewing the landscape treatment problem through the lens of risk assessment offers a more comprehensive framework to inform fuel treatment strategies in terms of location, amount, type, and spatial patterns of treatments. While risk provides a comprehensive index of likelihood, intensity, and potential effects, the measure needs to be decomposed to develop and analyze options for operational fuel treatment strategies. Specifically, wildfire risk factors combined with: 1) spatial pattern of values, 2) fire management objectives, and 3) fire regime, determine fuel treatment and overall fire management strategies. The risk factors determine the relative mix of intensity and likelihood of wildfire, while the spatial pattern of values determines the interaction of wildfire risk factors with values perceived to be at risk. Fire management objectives determine whether mitigation emphasizes restoring natural fire regimes, or suppression to protect highly valued resources (HVR), or a strategy in between. All of these components inform operational fuel treatment strategies.

The complexity and importance of a comprehensive fuels management program cannot be overstated. Local effectiveness depends heavily on the type of vegetation involved, the nature of the treatment, the spatial extent and location of treatments, and interactions of all of the above with topography, weather, infrastructure, and the suppression resources engaged if and when a wildfire occurs.

These complexities notwithstanding, it is informative to examine how broad-scale applications of fuel treatments might affect risk using basic models with simplifying assumptions. Fuel treatment scenarios were modeled spatially but very generally for each Fire Planning Unit (FPU) as part of the FPA process. The methods consisted of first soliciting treatment prescriptions by fuel and vegetation type from local fire planners. These prescriptions contained details on changes to surface fuel models and canopy characteristics that constitute treatments applicable to current fuel type descriptions. Then, an automated procedure applied these prescriptions to specific stands throughout the planning unit until roughly 15 percent of treatable landscape was treated. The quasi-random placement of treatment units meant that smaller areas within the planning unit varied considerably from this average figure. The treatment effect was estimated by running the fire behavior models for a treated landscape using identical simulation settings as for the reference baseline landscape. The contrast between risk metrics for each landscape illustrates the magnitude of possible changes resulting from this treatment level and considering only fuel types in placing treatments.

The FPA fuel treatment scenario resulted in modified burn probability (Figure 8) and conditional flame length across the Country. Intersecting these modified burn probability and flame lengths with the resource layers resulted in total national risk being reduced by 24 percent. Risk reduction to individual units was highly variable, ranging from an 11 percent increase in risk to 69 percent reduction in risk. This range of results is due largely to the following factors: 1) the arrangement of fuels relative to values, 2) the effectiveness of treatment in reducing fire spread and intensity in certain fuel types, and 3) how the individual planning units defined the treatment prescriptions that were evaluated.

Figure 8. Changes in simulated burn probability resulting from fuel treatments on 15% of each FPU (standard run minus treatment run). Thus, red and orange colors indicate increases in burn probability with treatment whereas green colors indicate reductions of burn probability (positive difference).



The effect of treatment on national risk to individual resource categories varied across categories. Beneficial effects of wildfire on fire adapted ecosystems were reduced while all other resources experienced a reduction in loss. Fire susceptible species experienced the lowest reduction of risk at 16 percent with recreational areas seeing a risk reduction of 63 percent. Populated areas that represented 58 percent of national risk in the standard run experienced a 23 percent reduction in risk. The ranking of geographical areas based on contribution to national risk did not change between the treated and standard runs. However, the relative contribution to national risk was reduced in the 2 highest ranked areas, California and Southern Area, while the Southwest, Great Basin, and Rocky Mountain all increased as a proportion of national risk.

Estimating changes in risk by looking at both burn probability and fire intensity is highly informative, but computationally demanding. By simplifying further and assuming that risk is proportional to area burned, the potential magnitude of changes in risk from fuel treatments can be examined using statistical approximation. A statistical model was fit to the simulation results during the FPA analysis completed in 2010. This model used a series of matched simulations to derive statistical relationships that use the fire spread inherent in a particular location, the weather conditions during a wildfire, and the extent of fuel treatment in the area surrounding the fire ignition point to estimate the expected size of each simulated wildfire. The statistical model fits the simulated data reasonably well in most planning units, with exceptions in some eastern states with highly fragmented fuel patterns. The statistical approximation approach promises to be useful for analyzing a broad range of options.

Option 3. Invest to Build Capacity in Fire Response

Analyzing investments in wildfire response can be very complicated. In addition to the complexities of fire behavior, one has to address interactions among the distribution of available resources, their performance on the fire, the dispatch logic used to send resources to a fire, and multiple operational constraints. The FPA includes a highly detailed Initial Response Simulator which addresses many of these issues, but is designed to only simulate responses in the first 18 hours following discovery of a wildfire. This simulator will be essential to understanding the feedback between initial attack effectiveness and behavior of fires that escape. Although poorly quantified at present, highly successful initial attack means that fires escape only under the rarest and most extreme weather conditions, becoming more severe. Thus, potential benefits to fuels or habitat from wildfires burning under moderate conditions are never realized, and, in turn, increases demand for initial attack effort and resources. Through more detailed analysis and the modeling in FPA, this feedback process may become understood and incorporated into the risk framework.

Once a wildfire has escaped initial containment efforts, further complications arise as resources are drawn from remote locations, fire behavior becomes difficult to predict, and even the objectives of the suppression response may change from day to day depending on circumstances that are not easily understood, much less modeled. Ongoing research directed at better understanding the management context and decision processes used in large fire suppression may lead to more reliable models that can capture the principal factors influencing performance—however it might be measured.

Option 4. Invest to Protect Values Exposed to Risk

The motivation behind options designed to lessen values at risk is relatively simple. If you cannot change the likelihood of a wildfire occurring, you might instead focus on lessening the chances that fire would have negative consequences. Such thinking motivates many of the activities focused at homeowners in the wildland-urban interface, who are taught to actively manage areas adjacent to their homes to reduce the chances of wildfires reaching their homes, or are encouraged to think ahead and have emergency supplies readily at hand and evacuation plans that can be implemented at a moment's notice. Similarly, important cultural or archeological sites may be managed in ways that offer passive resistance to wildfires. Species conservation plans also can be designed to manage risks by ensuring that no single event has the capacity to eliminate large blocks of the population or critical habitat.

Analyzing such options seems easy at first glance, but becomes increasingly difficult the better it is understood. In the analytical framework proposed above, reducing the exposure to risk is as simple as changing the response functions or benefit/loss values. This presumes, of course, that the appropriate values are addressed in the analysis to begin with and that the initial response functions accurately capture changes in value. Neither presumption is likely to go unchallenged. Although society generally agrees that human lives and property are important and should be protected, it seems that consensus often stops there. The range of other values that should be included in the analysis and how these values might change with fire can often be contentious. A second problem concerns the sensitivity of the response function to management actions. In the prototype risk analyses described above, stylized response functions were used that only crudely capture the effects of fire at varying intensities on values of concern. If the function is derived with little or no empirical basis, any change in that function could seem arbitrary without quantitative analyses to support it. Furthermore, the signal to noise ratio in the response function may be very weak and much of the change in the function due to proposed management actions may not rise to the level necessary to overcome the noise.

The net results of these considerations is that any action short of major shifts in policies or broad-scale changes in management are likely best left to local analyses that can be appropriately scaled to capture the appropriate changes.

An important concept related to reducing exposure is socioeconomic vulnerability. The intersection of human population, valued resources, and wildfire creates opportunities to strategically allocate wildfire response or prevention actions to minimize risk to human life and property. In the field of hazards, risk, and resiliency, a clear distinction is made between risk assessments which describe the expected loss of assets, and vulnerability assessments which characterize the exposure, sensitivity, and resilience of communities to a hazard. Both types of analyses apply to the goals and objectives of the National Cohesive Strategy.

In the risk assessment realm, additional research would address the expected impact of wildfires on economic activity and housing/infrastructure value. By looking at regional economic output in addition to the potential damage to structures a more complete view of the economic costs of wildfires can be compared across regions and among communities. Such analyses could, for example, highlight areas where natural resource or recreational dependent communities might be affected more severely by wildfire compared to communities with a diversified economic base.

Social vulnerability to natural hazards is a growing area of interdisciplinary research included in risk reduction strategies. Studies have analyzed how vulnerability varies among different segments of the population and how they will respond to a hazard, how hazards affect business and regional economic output, and how social vulnerability to hazards has changed over time across the US. This research attempts to characterize hazards and vulnerability from a more holistic perspective, particularly in the wake of natural disasters such as Hurricane Katrina or the Gulf Oil Spill, where economic damages do not fully represent the long term changes made to the physical, ecological, social and economic structure of the communities in the Gulf of Mexico.

IV. Risk Analyses at Smaller Spatial Scales

As stated above, the comparative risk framework can be applied to management problems at a range of scales. Three examples from ongoing and recently published work demonstrate this scalability. These include analyses at the scale of a Forest Service region, forest, and project. Regional analyses will play prominently in the early phase of the development of regional strategies, and in later implementation and monitoring. The forest and project examples will be particularly useful in later implementation phases of the National Cohesive Strategy and illustrate a consistent application of risk assessment and management across scales.

The Regional prototype is being developed in the Forest Service's Pacific Northwest Region (Region 6) and considers multiple threats (climate change, insect and disease, invasive plants) and values (carbon, critical habitat, etc.) to meet the needs of ongoing, regionally specific assessments. Thus the regional assessments can serve both local and national needs, the former having a scope beyond fire and fuels. The process leverages regional data sets to the extent they are available. Specific questions that are being addressed in the Region 6 example include:

- Are there associations among threats like wildfire, insects, and climate change that form spatial patterns in the region?
- Which human and ecological values are most associated with particular threats?
- How and where is management opportunities aligned with the occurrence of particular threat – value combinations?
- Where are restoration activities needed most and how are they associated with management opportunity?
- How can watersheds be ranked relative to the complete constellation of threats and values that face land managers?

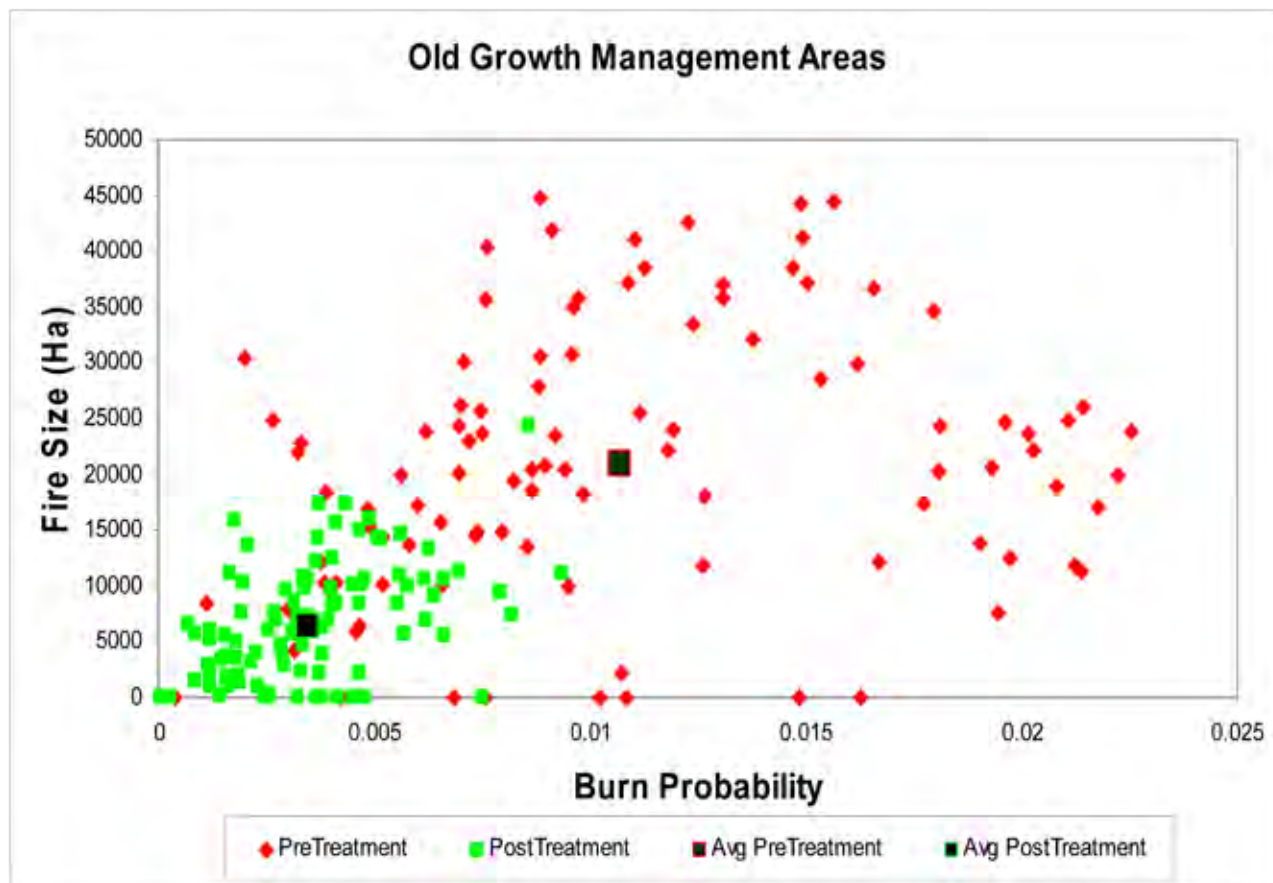
Risk analyses also can be applied at the level of a national forest or similar management unit to address a range of fuel treatment planning issues, including assessing the relative risk to resources of local values, and the assessment of treatment effectiveness for forest-wide plans. The example presented here was excerpted from a larger risk assessment study on the Deschutes National Forest in central Oregon. This work demonstrated the application of risk assessment to analyze the relative risk to human and ecological values. The assessment focused on three key questions of keen interest to Federal managers and policymakers:

- Are the wildfire risks to conservation and other forest plan reserves more or less than land designations receiving fuel treatments?
- What is the relative wildfire risk to urban interface areas compared to different land-use designations?
- Are specific conservation reserves responsible for the transmission of wildfire to other reserves?

The analyses revealed spatial variation in wildfire risk that is useful in prioritizing fuels treatments and guiding other wildfire mitigation activities. The work also illuminated the conflict between biodiversity conservation efforts on Federally managed lands and the high wildfire risk on fire-prone landscapes. In this study, estimates of burn probabilities and conditional flame lengths were used to examine the relative risk among land management allocations, conservation reserves, urban interface areas, and other designations on the Forest and surrounding lands. Thus, the highly valued resources were tiered directly to forest plan standards and management plan land designations. Selected outputs from these analyses revealed wide variation among and within polygons belonging to specific land designations, providing a clear identification of priority targets for mitigation activities. Specific designations and conservation reserves showed markedly higher conditional flame lengths, such as spotted owl active and potential home ranges. In contrast, the general forest matrix showed relatively high burn probabilities and lower conditional flame length. Most of the urban interface showed lower burn probability and expected flame length.

A fuel treatment priority map for the Forest was used to simulate fuel treatments and examine change in wildfire risk. The treatment scenario called for 64,000 ha of treatments in the general forest management areas. The ratio of the burn probability after and before the treatments was used to examine change in wildfire likelihood. The analysis suggested large reductions in burn probability in conservation areas and other reserves. For instance, the likelihood of a fire in the old growth reserves was 30 percent of the pre-treatment conditions. The effect of treatments on both burn probability and fire size for specific reserves like old growth show large reductions post treatment (Figure 9).

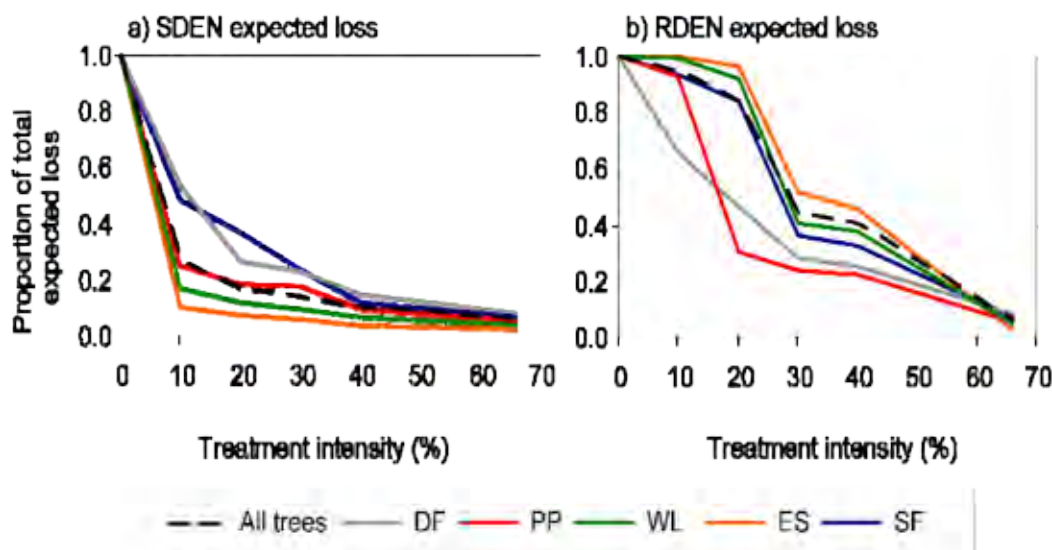
Figure 9. Change in burn probability and fire size to old growth units on the Deschutes National Forest after simulating treatments on about 20% of the forested areas. Treatments were not placed inside old growth units.



Example Project Scale Prototype

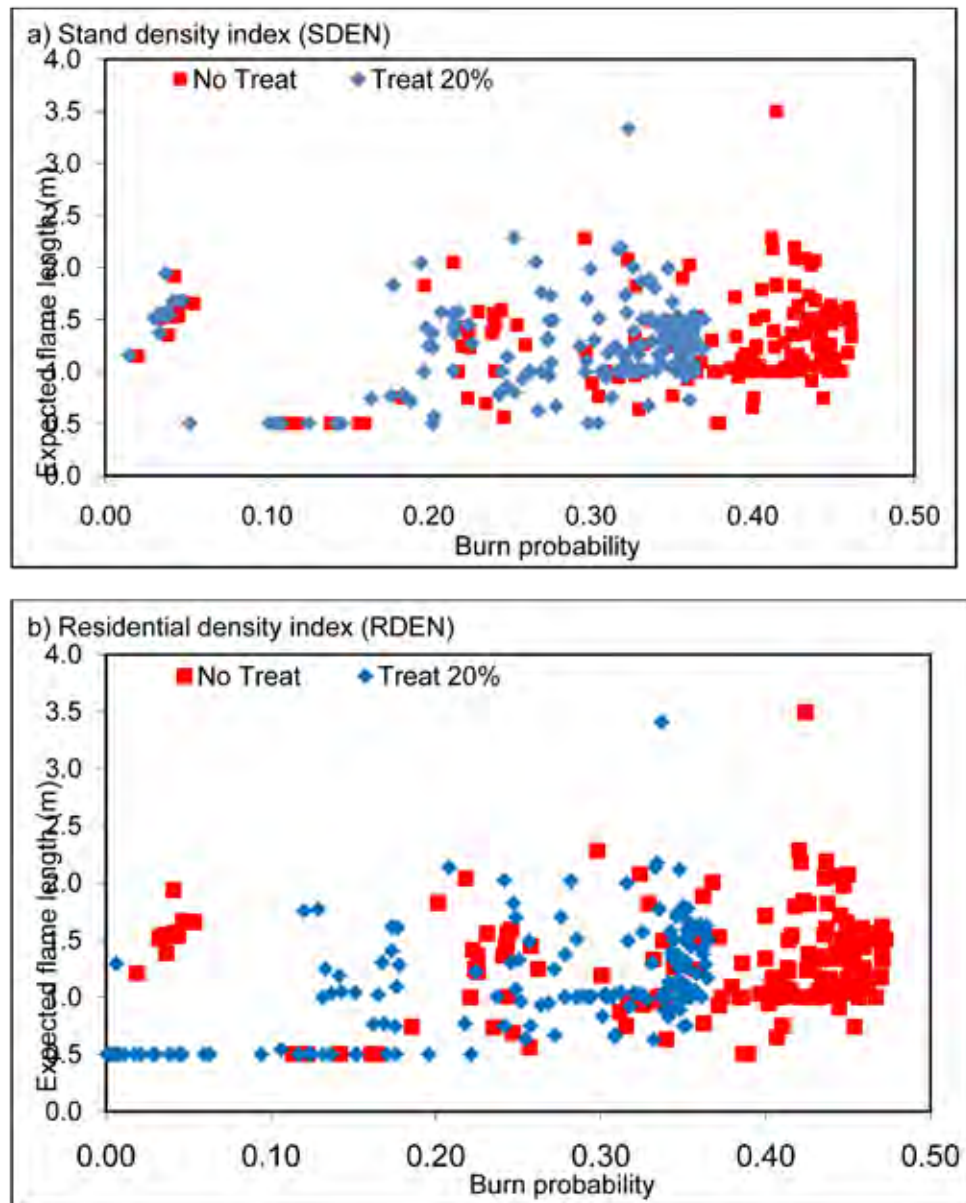
Individual project planning can readily benefit from targeted risk assessments. Ager and others (2010) used risk analysis to examine the tradeoff between landscape restorations versus protection of structures within a typical wildland-urban interface in eastern Oregon. The treatment strategies were evaluated by simulating 10,000 wildfires with random ignition locations and calculating burn probabilities by 0.5 m flame length categories for each 30 x 30 m pixel in the study area. The burn conditions for the wildfires were chosen to replicate severe fire events based on 97th percentile historic weather conditions. The burn probabilities were used to calculate wildfire risk profiles for each of the 170 residential structures within the urban interface, and to estimate the expected (probabilistic) wildfire mortality of large trees (>21 inches) that are a key indicator of stand restoration objectives. Expected wildfire mortality for large trees was calculated by building flame-length mortality functions using the Forest Vegetation Simulator, and subsequently applying these functions to the burn probability outputs. Results suggest that treatments on a relatively minor percentage of the landscape (10 percent) result in a roughly 70 percent reduction in the expected wildfire loss of large trees for the restoration scenario (Figure 10).

Figure 10. Graph from Ager et al (2010), which shows the expected loss of old growth trees (>53.3 cm diameter at 137.2 cm above ground) as a function of 6 treatment intensities and 2 spatial treatment scenarios. The graphs indicate that treatments in the urban interface area (RDEN scenario) are relatively ineffective at reducing expected loss of large trees compared to treatments in the wildlands (SDEN scenario) where stands were thinned to promote fire resiliency. Species codes are: DF: Douglas-fir, PP: ponderosa pine, WL: western larch, ES: Engelmann spruce, SF: subalpine fir.



Treating stands near residential structures resulted in a higher expected loss of large trees, but relatively lower burn probability and flame length within structure buffers. Substantial reduction in burn probability and flame length around structures was also observed in the restoration scenario where fuel treatments were located 5–10 km distant (Figure 11). This study demonstrated tradeoffs between ecological management objectives on wildlands (large fire resilient trees) versus protection of structures.

Figure 11. Example of flame length and annual burn probability scatter plots from Ager et al. (2010) showing values for individual structures for the Mt Emily wildland urban interface in northeastern Oregon. The stand density (SDEN) and residential density (RDEN) scenarios used different spatial treatment priorities that emphasized fire resiliency in the wildlands versus protection of structures in the urban interface. Points are average values for all pixels within a 45.7 m radius around each structure. The figure shows that burn probability, and to a lesser extent flame length, can be reduced around structures when fuel treatments are located outside the interface to address forest restoration and create fire resilient forests.



The Mount Emily study and others like it quantify off-site fuel treatment effects that often are not analyzed in fuel management studies. Moreover, they revealed spatial variation in burn probability and intensity that is useful for prioritizing fuels treatments to protect specific human and ecological values. This work advances the application of quantitative risk analysis to the problem of wildfire threat assessment for fuel treatment projects. Risk scatter plots and burn probability were developed as a decision tool to evaluate risk, prioritize treatments, and measure the potential treatment effects. The methods employed here demonstrated a quantitative approach to risk assessment using existing models that are widely used within the USDA Forest Service and other public land management agencies in the US.

V. Historic Range of Variability for Wildfire Risk

One of the more engaging discussions that occur frequently is whether historical levels of wildland fire can be restored and sustained. Quantitative risk analysis was performed for an assumed historical condition that would serve as a baseline for comparing modern risk in areas where ecological processes and ecosystem sustainability are likely and possible objectives. This historical risk is not applicable where lands are no longer managed for ecological sustainability. Sustainability is defined by both disturbance processes and vegetation/ecosystem structure (including vegetation and wildlife species and populations). Maps delineating these land management objectives were not available, and for demonstration purposes, public land was used to indicate potential areas.

The procedures for producing the historical risk analysis are based on LANDFIRE data products. Two main risk components, namely average historical burn probability and distributions of fire severity, were derived from LANDFIRE layers of mean fire return interval (MFRI) and biophysical setting (BPS), respectively. A national map of each of these data themes was created for the conterminous United States at a resolution of 270 meters. Historical Burn Probability was derived from the MFRI data which represent 22 classes of average historical fire intervals. The reciprocal of the midpoint of the interval is the estimated historical burn probability. The Historical Fire Severity Distribution was derived from the BPS data theme which represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement. Each BPS map unit was matched to a vegetation succession model which includes information on disturbance regimes, including fire. For each succession model the probability of three fire severity types: surface, mixed and stand replacement were available. The fire severity types were linked back to the individual BPS vegetation map units so that they could be spatially analyzed in concert with the derived historical burn probability. The absolute probability of a specific fire severity was then the product of the historic burn probability and the conditional fire severity probability. The historical probability and severity information was then used to analyze the historical risk to contemporary high valued resources and compared with modern risk.

Comparison of the historical and modern risk components reveals the well known shift toward much lower rates of burning than historically existed. Burn probabilities for almost all areas are lower now than under historical conditions (Figure 12). The ratio of modern to historical probabilities identifies many places where the departure is the greatest – particularly in forests (Figure 13). Much higher burn probabilities occurred historically in agricultural areas no longer managed for wildland values. However, the ratio map also indicates substantial regions of the West and Southwest where burn probabilities are actually higher today. These correspond to places where invasive annual grasses have contributed to higher burning rates and larger fires than historical conditions could sustain (for example cheat grass replacing sage brush in the Great Basin). The same trend appears where excessive numbers of human ignitions occur adjacent to urban areas.

Figure 12. Historical burn probabilities derived from LANDFIRE data layers. These probabilities are substantially higher than modern probabilities (see Figure 3).

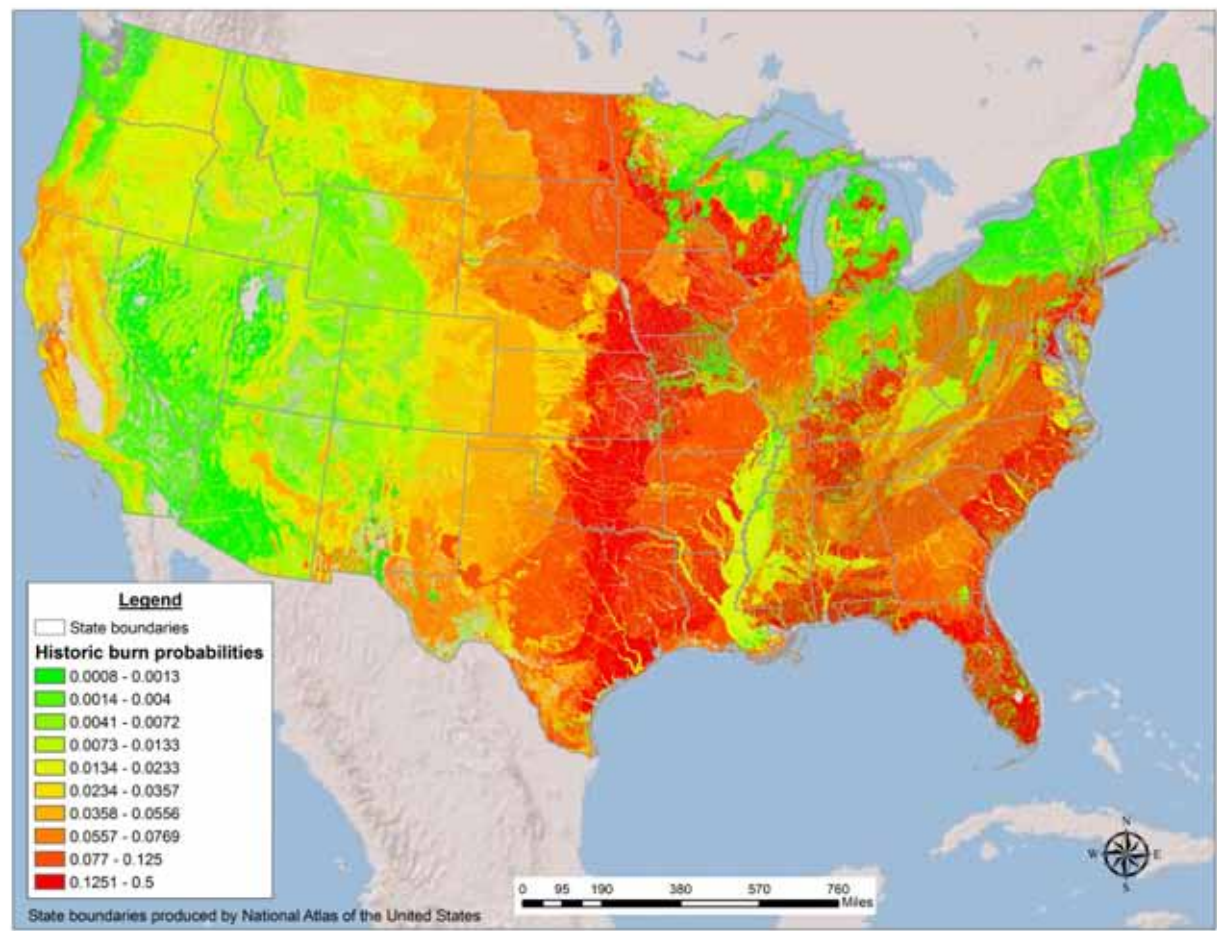
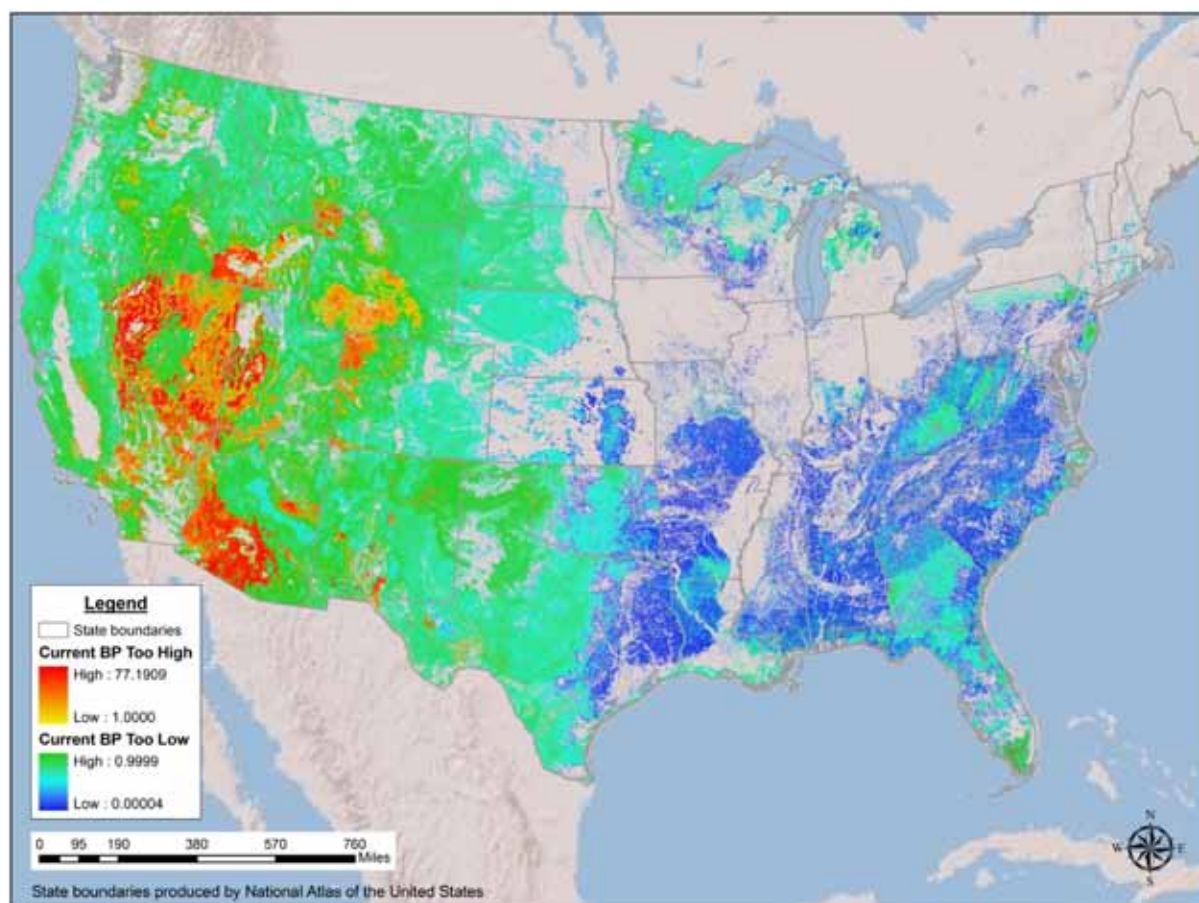


Figure 13. Ratio of modern to historical burn probabilities. Ratios are higher now than historical values in the Southwest and Great Basin, likely because of invasive grasses and increased human ignition. Ratios are substantially lower today in most of the forest types of the Country than historically existed.



Sustainability

The combined use of the historical risk components and treatment effectiveness suggests areas and frequencies of fire that would be important to sustaining ecological process and structure. For many lands, historical fire regimes are not consistent with modern land use objectives. Some lands, particularly some public lands in the west, however, do have management objectives consistent with ecosystem sustainability for which the historical conditions are a relevant comparison. As an example calculation, the large public ownership in the west is where historical fire regimes confer a net reduction in risk. This includes increased rates of burning in many low elevation forest types as well as fuel treatments to decrease rates of burning in some desert shrublands. Using the estimates of historical and modern burning rates by ecoregion on Federal lands in the west, it is possible to estimate the amount of area requiring annual burning. Summary tables were generated of the annual acres burned historically by ecoprovince and under the current fire regime. The difference is the total additional area requiring burning by ecoprovince achieving estimated historical burning rates. This same process could be used ultimately to estimate the area requiring burning by severity class or intensity class that conforms to historical regimes.

If it were a goal to return fire to the wild landscapes of the west, the amount of annual burning that would occur is substantially more than is currently occurring. Using a few ecoprovinces as examples indicates how much of an increase in burning would occur (Table 1). For instance, the Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow Province historically burned over 490,000 acres per year whereas now the area burns approximately 72,000 acres per year. Achieving the historic burn rate would be an increase in burning of approximately 500 percent above current. The Nevada-Utah Mountains-Semi-Desert-Coniferous Forest-Alpine Meadow Province historically burned over 222,000 acres compared to approximately 155,000 acres now. Achieving the historic burn rate would be an increase in burning of approximately 43 percent above current. The Sierran Steppe-Mixed Forest-Coniferous Forest-Alpine Meadow Province historically burned over 803,000

acres compared to approximately 70,000 acres now. Achieving the historic burn rate would be an increase in burning of approximately 1,047 percent or ten times the amount of burning. On Federal lands in the eastern U.S, even more dramatic contrasts are seen between estimated historical burning rates than the modern rates. Burning rates would have to increase by thousands of percent for most ecoprovinces. The historical contribution of Native American burning practices to the historical fire regime in many of these areas would probably have to be considered dominant over natural ignitions.

The issue of smoke management and tolerance will play a considerable role in decisions regarding the degree to which fire will be tolerated on the landscape. If the goal is to return fire to the landscape on these ecoprovinces to the extent it likely existed in the pre-European settlement era, smoke tolerance constraints are likely to limit implementation. It warrants discussion concerning the potential goal to increase fire on the landscape, but to what degree. It is shown here that achieving the same level of burning as pre-European settlement would involve dramatic shifts from current burning levels in most regions even if wildfire, prescribed fire, and fuels treatment were jointly counted toward the acres burned level.

Conclusions

Living with and managing wildland fire inherently involves facing uncertainty and the potential for catastrophic losses. Ultimately, the success of the Cohesive Wildland Fire Strategy may hinge on how well risk is properly understood, quantified, and managed. Formal comparative risk assessment as described above could provide a sound foundation for analyzing and evaluating alternative management strategies. The examples shown above demonstrate the types of risk analyses made possible with modern information and tools at multiple planning scales. Additional information and details are available in the complete report of the science panel, which also addresses additional issues relevant to wildland fire and risk assessment. Information provided above and in the complete report establishes a solid foundation for moving forward.

Table 1. Examples of estimated historical burning rates as compared to current rates for selected ecoprovinces in the western United States

Ecoprovince	Historical Burn Rate (ac/yr)	Current Burn Rate (ac /yr)	Net Diff. (ac/yr)	Historical % of Current
Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow	493,123	72,071	421,052	584%
Nevada-Utah Mountains-Semi-Desert-Conif Forest-Alpine Meadow	222,107	155,215	66,891	43%
N. Rocky Mountain Forest-Steppe-Conif Forest-Alpine Meadow	159,945	17,107	142,837	835%
Sierran Steppe-Mixed Forest-Coniferous Forest-Alpine Meadow	803,369	70,324	733,045	1,042%
S. Rocky Mtn Steppe-Open Woodl.-Conif Forest-Alpine Meadow	507,141	114,478	392,662	343%
Southwest Plateau and Plains Dry Steppe and Shrub	59,769	2,968	56,800	1,914%

Authors of the report: Danny C Lee, Alan A. Ager, Dave E. Calkin, Mark A. Finney, Matthew P. Thompson, Thomas M. Quigley, and Charles W. McHugh.

Literature Cited

Ager, A. A., Vaillant, N. M., Finney, M. A. (2010). A comparison of landscape fuel treatment strategies to mitigate wildland fire risk in the urban interface and preserve old forest structure. *Forest Ecology and Management* 259: 1556-1570.

Prestemon, J. P., Butry, D. T., Abt, K., Sutphen, R. (2010). Net benefits of wildfire prevention education efforts. *Forest Science* 56(2): 181-192.

USDA Forest Service (in review). A Comparative Risk Assessment Framework for Wildland Fire Management: Science Report to the Cohesive Strategy Oversight Committee.

APPENDIX B: GLOSSARY

An extensive glossary of fire management terminology and acronyms is maintained by the National Wildfire Coordinating Group (NWCG) as found at www.nwcg.gov/pms//pubs/glossary/index.htm. Some of the important terms used in this document that have specific meaning in the context of wildland fire management, but are not currently found in the NWCG glossary, are defined below.

Affected party	A person or group of people who are affected by the outcome of a decision or action.
Fire-adapted community	Human communities consisting of informed and prepared citizens collaboratively planning and taking action to safely co-exist with wildland fire.
Fire-adapted ecosystem	An ecosystem is “an interacting natural system, including all the component organisms, together with the abiotic environment and processes affecting them.” (NWCG Glossary). A fire-adapted ecosystem is one that collectively has the ability to survive or regenerate (including natural successional processes) in an environment in which fire is a natural process.
Fire community	A term that collectively refers to all those who are engaged in any aspect of wildland fire-related activities.
Fire exclusion	The land management activity of keeping vegetation or ecosystems from burning in a wildland fire.
Fire management community	A subset of the fire community that is has a role and responsibility for managing wildland fires and their effects on the environment.
Fire science community	A subset of the fire community consisting of those who study, analyze, communicate, or educate others on the components of fire management that can be measured, such as fire behavior, fire effects, fire economics, and other related fire science disciplines.
Resilient	Generally referred to in this document as “resilient ecosystems,” which are those that resist damage and recover quickly from disturbances (such as wildland fires) and human activities.
Stakeholder	A person or group of people who has an interest and involvement in the process and outcome of a land management, fire management, or policy decision.

APPENDIX C: ACRONYM LIST

CWPP	Community Wildfire Protection Plan
DOI	Department of the Interior
EMDS	Ecosystem Management Decision Support system
FLAME Act	Federal Land Assistance, Management, and Enhancement Act
FPA	Fire Program Analysis
FPU	Fire Planning Unit
GAO	General Accounting Office
HVR	Highly Valued Resource
IAFC	International Association of Fire Chiefs
NASF	National Association of State Foresters
NFPA	National Fire Protection Association
NICC	National Interagency Coordination Center
NIFC	National Interagency Fire Center
NVC	Net Value Change
NWCG	National Wildfire Coordinating Group
PDSI	Palmer Drought Severity Index
USDA	US Department of Agriculture
WFDSS	Wildfire Decision Support System
WFEC	Wildland Fire Executive Council
WFLC	Wildland Fire Leadership Council
WUI	Wildland-Urban Interface

APPENDIX D: REFERENCES

Cohesive Wildland Fire Management Strategy Foundational Documents

2009 Quadrennial Fire Review (QFR), <http://www.nifc.gov/QFR/index.htm>

National Policy Framework Documents including:

- *A Call to Action*, <http://www.nifc.gov/QFR/index.htm>
- *Mutual Expectations for Preparedness and Suppression in the Interface*, http://www.forestsandrangelands.gov/strategy/documents/mutual_expectations_2010.pdf
- *Wildland Fire Protection and Response in the United States, The Responsibilities, Authorities, and Roles of Federal, State, Local, and Tribal Government*, <http://www.forestsandrangelands.gov/strategy/documents/ildlandfireprotectionandresponseusaug09.pdf>

References and Documents (1999-2009)

Western National Forests: A Cohesive Strategy is needed to address Catastrophic Wildland Fire Threats. U.S. General Accounting Office, 1999

A Cohesive Strategy the Forest Service Management Response to the General Accounting Office Report, GAO/RCED-99-65, April 13, 2000

Managing the Impacts of Wildfire on Communities and the Environment – A Report to the President in Response to the Wildfires of 2000. Fire and Aviation Management, USDA Forest Service

A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: A 10-Year Strategy. Western Governors Association, 2001

Restoring Fire-Adapted Ecosystems on Federal Land. U.S. Department of the Interior and USDA Forest Service, 2002

Wildland Fire Management: Important Progress Has Been Made, but Challenges Remain to Completing a Cohesive Strategy. U.S. Government Accountability Office, January 2005

Quadrennial Fire and Fuel Review Final Report 2005. The National Wildfire Coordinating Group Executive Board, July 2005

Protecting People and Natural Resources – A Cohesive Fuel Treatment Strategy, US DOI, Released April 2006

Wildland Fire Management: Update on Federal Agency Efforts to Develop a Cohesive Strategy to Address Threats. U.S. Government Accountability Office, May 2006

Wildland Fire Management: Federal Agencies Have Taken Important Steps Forward, but Additional Strategic Action is needed to capitalize on Those Steps. U.S. Government Accountability Office, September 2009

Briefing paper: State Forestry Agency Perspectives Regarding 2009 Federal Wildfire Policy Implementation, July 2010 <http://www.stateforesters.org/files/201007-NASF-FedFirePolicy-Briefing-Paper.pdf>

Briefing paper: Identifying Communities at Risk and Prioritizing Risk-Reduction Projects, July 2010 <http://www.stateforesters.org/files/201007-NASF-CAR-Briefing-Paper.pdf>

APPENDIX E: WILDLAND FIRE LEADERSHIP COUNCIL MEMBERSHIP

U.S. Department of Agriculture, Undersecretary for Natural Resources and Environment
 U.S. Department of Agriculture, Deputy Undersecretary for Natural Resources and Environment
 Chief of the Forest Service
 U.S. Department of the Interior, Assistant Secretary for Policy Management and Budget
 Director, Bureau of Indian Affairs
 Director, Bureau of Land Management
 Director, National Park Service
 Director, U.S. Fish and Wildlife Service
 Director, U.S. Geological Survey
 Department of Homeland Security, U.S. Fire Administration, Administrator

In addition to the Federal officials, WFLC includes seven non-Federal members comprised primarily of senior elected officials of state, tribal, county and municipal governments, including a state governor representing the National Governors' Association, a state governor representing the Western Governors' Association, the president of the Intertribal Timber Council, a county commissioner representing the National Association of Counties, and a mayor representing the National League of Cities. These elected officers, along with a state forester designated by its governor and a fire chief designated by its elected official, are invited to participate with the WFLC due to their interest in and statutory responsibility for wildland fire management.

Current membership of WFLC includes:

Member	Agency
Rhea Suh, Assistant Secretary for Policy, Management and Budget, WFLC Chair	Department of the Interior
Jay Jensen, USDA Deputy Undersecretary for Natural Resources and the Environment	United States Department of Agriculture (USDA)
Tom Tidwell, Chief	USDA Forest Service
John Jarvis, Director	National Park Service
Rowan Gould, Acting Director	United States Fish and Wildlife Service
Bob Abbey, Director	Bureau of Land Management
Mike Black, Director	Bureau of Indian Affairs
Marcia McNutt, Director	United States Geological Service
Glenn Gaines, United States Fire Administration	Department of Homeland Security
Ted Kulongoski, Governor, State of Oregon	Governor Western States Representative
Dan Shoun, County Commissioner, Lake County, State of Oregon	Counties Representative
Joe Durglo, President, Confederated Salish and Kootenai Tribes	President, Intertribal Timber Council
Mary Hamann-Roland, Mayor, City of Apple Valley	National League of Cities
Jeff Jahnke, State Forester, State of Colorado	Designated representative for the National Association of State Foresters
Chief Robert Roper, Ventura County (California) Fire Department	Designated representative for the International Association of Fire Chiefs

APPENDIX F: COHESIVE STRATEGY OVERSIGHT COMMITTEE

Name	Affiliation
Tom Harbour	USDA Forest Service
Kirk Rowdabaugh	United States Department of the Interior
Maureen Hyzer	USDA Forest Service
Clint Cross	USDA Forest Service
Tim Sexton	USDA Forest Service
Bill Van Bruggen	USDA Forest Service
Susan Stewart	USDA Forest Service
Dan Smith	National Association of State Foresters
Caitlyn Pollihan	National Association of State Foresters
Douglas MacDonald	International Association of Fire Chiefs
Bryan Rice	Bureau of Indian Affairs
Joshua Simmons	Bureau of Indian Affairs
Michael Carrier	Western Governors' Association
Ann Walker	Western Governors' Association
Lynda Boody	Bureau of Land Management
Wendy Reynolds	Bureau of Land Management
Dan Buckley	National Park Service
John Morlock	National Park Service
Ryan Yates	National Association of Counties
Aitor Bidaburu	United States Fire Administration
Jim Kelton	United States Fish and Wildlife Service
Jim Erickson	Intertribal Timber Council

APPENDIX G: PROJECT MANAGEMENT TEAM

Name	Agency
Lew Southard	USDA Forest Service
Jeff Whitney	USDA Forest Service
Sandy Cantler	USDA Forest Service
Priscila Franco	USDA Forest Service
Pete Lahm	USDA Forest Service
Mike Hiburner	USDA Forest Service
Christie Wiley	USDA Forest Service
Roy Johnson	Department of the Interior
Peter Teensma	Department of the Interior
Bradley Washa	Bureau of Land Management
Erik Berg	United States Geological Survey
Ann Walker	Western Governors' Association
Al Hyde	Contractor
Mark Bieghley	Contractor
Tom Quigley	Contractor
Writer/Editor Group	
Members of the CSOC	
Cheryl Renner, Contractor	
Sheri Ascherfeld, Graphic Designer	
Science Group	
Danny C. Lee	
Alan A. Ager	
Dave E. Calkin	
Mark A. Finney	
Matthew P. Thompson	
Thomas M. Quigley	
Charles W. McHugh	

APPENDIX H: WILDLAND FIRE EXECUTIVE COUNCIL MEMBERSHIP

Director, USDA Forest Service, Fire and Aviation Management

Director, DOI Office of Wildland Fire Coordination

Assistant Administrator U.S. Fire Administration

Chair, National Association of State Foresters (NASF) Fire Committee

Chair, International Association of Fire Chiefs (IAFC) Wildland Fire Policy Committee

Representative, Intertribal Timber Council (ITC)

Representative, National Association of Counties (NACo)

Representative, National League of Cities (NLC)

Chair, National Wildfire Coordinating Group (NWCG)

APPENDIX I: PROCESS OVERVIEW

With the passage of the Federal Land Assistance, Management and Enhancement Act (FLAME Act) in October 2009, the Secretaries of the Interior and Agriculture were directed, in part, to provide a report to Congress addressing seven specific elements and a cohesive wildland fire management strategy, consistent with recommendations in recent Government Accountability Office reports. The report was due back to Congress within one year.

Recognizing that a true national cohesive strategy must include all levels of fire management, the Wildland Fire Leadership Council (WFLC), an intergovernmental committee of fire program leaders representing Federal, state, tribal, county and municipal interests, subsequently appointed a 24-member Cohesive Strategy Oversight Committee (CSOC) to complete the tasks assigned in the FLAME Act. The CSOC membership represented a broad cross-section of interests, including seven state, local, tribal and non-governmental organization representatives; five members each from the Department of the Interior and USDA Forest Service, including senior agency members; four Federal regional line officers; and three additional Federal partners.

The purpose of the CSOC was to formulate strategy goals, options and trade-offs; to establish technical assessments provided by science research; and to seek field comments and other relevant studies, reports and documents to provide an overarching foundational document for WFLC and agency review.

In the performance of its work, the CSOC held 14 regional forums with diverse groups of stakeholders to gather input regarding critical issues, values, timelines, concerns, priorities, and planning. These forums were held in locations throughout the Country from Alaska to Virginia and drew more than 450 attendees and garnered 375 comments. Concurrent with the forums, a science panel developed a report containing a risk analysis framework example to accompany the strategy formulation.

Initial drafts of the FLAME Act/GAO Report, a collaboratively designed cohesive strategy and Science Report were produced by early August and distributed among the CSOC members and others for comment. The initial drafts were revised in mid-August and subsequently presented to WFLC for review and acceptance on August 25. With WFLC's comments and approval, the documents were carried forward for additional refinement.

Additionally, the latter draft was distributed for comment to more than 300 individuals and groups who previously requested an opportunity to be involved in the process as it unfolded. Of these, more than 80 responses containing more than 300 pages of comments were returned.

In its fourth general meeting, held in St. Paul, Minnesota September 13-16, the CSOC considered and incorporated comments received as it further refined the documents in preparation for submission back to WFLC.