Appropriate Management Responses to Wildland Fire: Options and Costs[1]

G. Thomas Zimmerman[2]

Abstract

The Federal Wildland Fire Management Policy and Program Review, chartered and completed in 1995, represents the latest stage in the evolution of wildland fire management. The concept of appropriate management response is central to this policy. Through this approach, management responses are developed to reflect resource management needs and constraints, maximize a commitment to safety, be cost-effective, and accomplish desired objectives while maintaining the flexibility to vary intensity as conditions change. This concept accommodates use of the full range of responses. During the 1998 fire season in the Northern Rocky Mountains, appropriate management responses were developed consistent with the new policy and the full range of options. The appropriate management responses that were applied during August and September are discussed, with emphasis on descriptions of actions, ranges of costs, and contrasts among various responses. Specific examples of concurrent selected wildland fire use and suppression complexes are provided.

Throughout the 20th century, fire management policy and operational management have continued to develop in response to increasing land and resource management needs, expanding knowledge of the natural role of fire and suppression capability and effectiveness. During the early stages of wildland fire management, state-of-the-knowledge indicated that the preferred solution to limit widespread, damaging fires was aggressive, total suppression. As knowledge, understanding, and experience grew, it became increasingly obvious that complete fire exclusion was not the method to support a balanced resource management program. In fact, in many situations, this management direction was detrimental to ecosystem health and function.

Increasing awareness and concern among Federal land management agencies and constituents about safety, the impacts of wildland fire, and integration of fire and resource management resulted in a review of Federal wildland fire management policy. The Secretaries of the Interior and Agriculture convened a review to reaffirm and ensure that uniform Federal policies and cohesive and cooperative interagency and intergovernmental fire management programs existed. In response, the Federal Wildland Fire Management Policy and Program Review was chartered and completed in December 1995 (USDI /USDA 1995).

Under previous policy, Federal agencies' operational management options were limited by discrete classification of fire types. Operational efficiency was often compromised when fires were forced into specific categories. Frequently, managers were directed into responses because of policy guidelines and established rigid procedures rather than through consideration of resource management needs and desired objectives. Fiscal guidelines also drove management responses by limiting available funds for management options other than suppression. Economic efficiency was, in many instances, not fully evaluated during decision-making.

Challenges and risks pervasive to wildland fire management are increasing in both complexity and extent. Threats from wildland fires grow each year as long-term effects from past land use and fire management actions dominate

[1]An abbreviated version of this paper was presented at the Symposium on Fire Economics, Planning, and Policy: Bottom Lines, April 5-9, 1999, San Diego, California.

[2]Fire Science and Ecological Applications Program Leader, USDI National Park Service, National Interagency Fire Center, Boise, ID 83705; e-mail tom_zimmerman@nps.gov.

natural vegetation communities. In addition, escalating values to be protected associated with current land use practices are compounding protection concerns and rapidly overextending Federal land management agencies' ability to respond to these challenges.

The future demands increased efforts to dramatically improve fire management program efficiency and accomplish resource management objectives. Wildland fire management policy and procedures must evolve to reflect new and critical considerations, capabilities, and direction, while being responsive to resource management objectives. Federal fire management agencies must change their expectations that all wildland fires can and should be controlled and suppressed. Absolute protection is an expectation that is difficult, if not impossible to achieve, and on the basis of workforce limitations, safety concerns, fiscal constraints, and environmental and fire behavior variables, is unrealistic. Operational implementation procedures must be developed that are commensurate with resource management objectives, safety, and cost efficiency. Incorporation of the best science, latest knowledge, and emerging technology will facilitate and support the highest quality and most effective fire management decisions and accomplishments.

Federal Wildland Fire Management Agencies are in the process of fully implementing the 1995 Federal Wildland Fire Management Policy. During the 1998 fire season, fire activity in the Northern Rocky Mountains provided a significant opportunity to put the new policy into practice. This paper clarifies the new Federal wildland fire management policy and appropriate management response concept; characterizes the range of appropriate management responses used during August and September, 1998 in the Northern Rocky Mountains, in terms of interrelationships among management objectives, land use, and operational actions; and presents wildland fire costs and contrasts them along the full spectrum of appropriate management responses.

Federal Wildland Fire Management Policy Discussion

The federal wildland fire management policy represents the latest stage in the evolution of wildland fire management and recommends policy changes that associate suppression and management of wildland fires into a single direction achieving multi-dimensional objectives. This policy directs Federal agencies to achieve a balance between suppression to protect life, property, and resources, and fire use to regulate fuels and maintain healthy ecosystems. Many of the previous limitations to expanded fire use are eliminated by this policy.

Differences between the previous and current Federal wildland fire management policy are typified by previous classification requirements that all fires were either wildfires or prescribed fires. This arbitrary classification of fires by types precluded maximum management effectiveness and strategic implementation. Under the new policy, all fires not ignited by managers for predetermined objectives are considered wildland fires. All wildland fires, then, have the same classification and receive management actions appropriate to conditions of the fire, fuels, weather, and topography to accomplish specific objectives for the area where the fire is burning. These management actions are termed the appropriate management response and will vary among individual fires. This type of management activity permits a dynamic range of tactical options that allows managers to continually operate at the most effective level. The new policy advocates greater application and use of fire for accomplishing resource benefits while maintaining and implementing an effective suppression program.

Key points made in the 1995 Policy Report (USDI/USDA 1995) include:

- Protection of human life is reaffirmed as the first priority in wildland fire management. Property and natural/ cultural resources are the second priority, with protection decisions based on values to be protected and other considerations.

- Wildland fire, as a critical natural process, must be reintroduced into the ecosystem. This will be accomplished across agency boundaries and will be based on the best available science.
- Agencies will create an organizational climate that supports employees who implement a properly planned program to reintroduce wildland fire.
- Where wildland fire cannot be safely introduced because of hazardous fuel build-ups, some form of pretreatment must be considered, particularly in wildland / urban interface areas.
- Every area with burnable vegetation will have an approved fire management plan.
- Both wildland fire management decisions and resource management decisions will be considered based on approved fire management and land and resource management plans. At the same time, agency administrators must have the ability to choose from the full spectrum of fire management actions --- from prompt suppression to allowing fire to function in its natural ecological role.
- All aspects of wildland fire management will be conducted with the involvement of all partners; programs, activities, and processes will be compatible.
- Agencies will develop and use compatible planning processes, funding mechanisms, training and qualification requirements, operational procedures, values-to-be-protected methodologies, and public education programs for all fire management activities.

Considerable confusion and misinformation has been associated with implementation of the new policy. New direction and opportunities represent marked departures from previous policy activities. To alleviate confusion and facilitate understanding and implementation, the intent of the policy can be graphically illustrated. A flowchart can represent an interagency-approved diagram, illustrating the broad framework of the new policy *(fig. 1)*. This flowchart is an interagency-approved diagram forming the basis for policy description, illustration, and development of implementation procedures. The

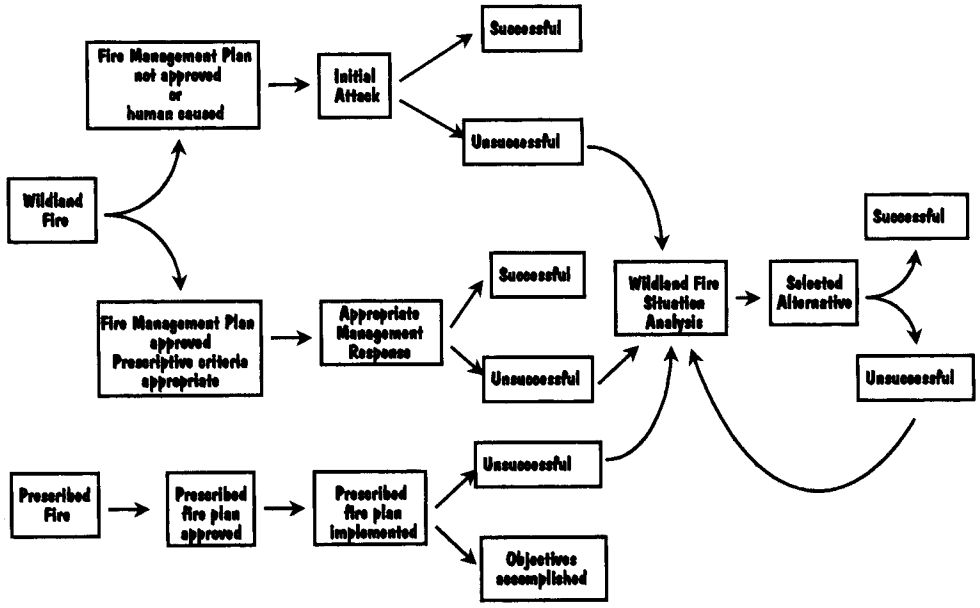

Figure 1

National Wildfire Coordinating Group (NWCG) Wildland Fire Management Policy flowchart (disseminated throughout the five Federal fire management agencies via internal agency communication directives).

flowchart depicts all ignitions as either wildland or prescribed fires. Wildland fire management can follow one of two pathways, depending upon completion of an administrative unit fire management plan.

Fire management plans, prepared by each administrative unit, or jointly by multiple units, are prerequisite to operational implementation. When a fire management plan is lacking, incomplete, or not approved, management options are substantially reduced. Without a plan, units may only implement initial attack suppression strategies. When a fire management plan has been completed and approved, and wildland fires are from natural ignition sources, the full extent of management options is available. These options range from monitoring with minimal on-the-ground actions to intense suppression actions on all or portions of the fire perimeter. The appropriate management response is developed from analysis of the local situation, safety, values-to-be-protected, management objectives, external concerns, fiscal concerns, and land use. Appropriate management responses resulting in aggressive suppression actions on unwanted fires correspond to old policy actions taken to suppress wildfires. Appropriate management responses resulting in management of wildland fires for resource benefits correspond to old policy actions of prescribed natural fire management. Under the new policy, opportunities to combine these strategies on individual fires are unlimited, implementing a variety of options concurrently is possible, and a distinction between fire types or strategic responses is eliminated.

The appropriate management response is the cornerstone of the new policy. Every wildland fire will receive an appropriate management response. Through its application, managers have the ability to maximize opportunities presented by every wildland fire situation. Appropriate management responses are neither replacements to prescribed natural fire nor alternatives to suppression. Managing fires for resource benefits and suppressing unwanted fires are basic strategic categories that are accomplished during implementation of one or more tactical options along the full spectrum of appropriate management responses. Appropriate management responses can be developed along a continuum from monitoring to aggressive suppression.

Range of Appropriate Management Responses Applied in 1998

During early August 1998, widespread lightning activity ignited over 200 wildland fires in the Northern Rocky Mountains. These fires were scattered throughout northern Idaho and western Montana on National Forest and National Park lands. Consistent with the new policy, appropriate management responses were applied to all fires. Assessments were made of underlying land management objectives, values-to-be-protected, primary land use, external influences, and other information pertinent to the fire location and situation. Conditions dictated that numerous fires receive an immediate management response to accomplish protection objectives through suppression. Other fires, actually a greater number than were suppressed, received management responses appropriate to realize opportunities to accomplish resource benefits, while maximizing firefighter safety by minimizing exposure, and remaining commensurate with cost effectiveness.

During this time, newly updated agency manuals had not been officially approved for the USDA Forest Service (USFS). As a result, it was not possible to fully implement the new policy in terminology, although fiscal allowances, management coding, and management responses were in place permitting consistency with new policy direction. The end result was that all wildland fires on National Forest lands managed for resource benefits during 1998 were described as prescribed natural fires to comply with agency manual direction in use at that time. Although this situation had little influence on the eventual outcome, it did foster limited confusion regarding terminology.

Table 1-*Wildland fires managed for resource benefits by the USDA Forest Service and USDI National Park Service, 1994-1998.*

Agency	Numbers of wildland fire use actions by years[1]				
	1994	1995	1996	1997	1998
Forest Service (USFS)	26	91	164	70	113
National Park Service (NPS)	68	51	83	96	101
Total number of wildland fire use actions	94	142	247	166	214

[1]Source: USFS and NPS file data, National Interagency Fire Center

A major difference separating the 1998 management effort from those of past years is related to the localized magnitude of fires managed for resource benefits. In previous years, fixed budgets severely limited the scale of prescribed natural fire accomplishments. Natural fire management budgets for both the USFS and USDI National Park Service (NPS) controlled the numbers of, and occasionally, the duration of prescribed natural fires. Once these budgets were exhausted or fully committed to potentially long-duration fires, all other new ignitions were forced into a wildfire designation and received an initial attack suppression response. If large resource commitments were not warranted, confinement responses were implemented.

During the past 5 years, the numbers of wildland fires managed for resource benefits shows a gradual increase, then slight drop off, reflecting seasonal severity and total numbers of ignitions *(table 1)*. The total number of fires managed for resource benefits in 1998 was not the highest on record *(table 1)*. But, instead of this total being comprised of fires occurring throughout the western United States, it was made up almost exclusively of fires concentrated in the Northern Rocky Mountains. More than 100 wildland fires were managed for resource benefits on the Flathead, Nez Perce, Payette, Salmon-Challis, and Bitterroot National Forests and Glacier National Park. The significance of managing this number of fires for this purpose becomes clear when understanding that during previous years, 75 percent of these fires would have been suppressed through aggressive initial attack or extended attack.

Because of the large numbers of fires in a few individual units, many fires in Idaho and Montana were aggregated into complexes to facilitate management *(fig. 2)*. Those fires and complexes that represent the greatest range of appropriate management responses that will be discussed in this paper include: Rock Rabbit Fire, and Kootenai, Moose, West Fork, Main Salmon, Powell, North Fork, and Bitterroot complexes *(fig. 2)*.

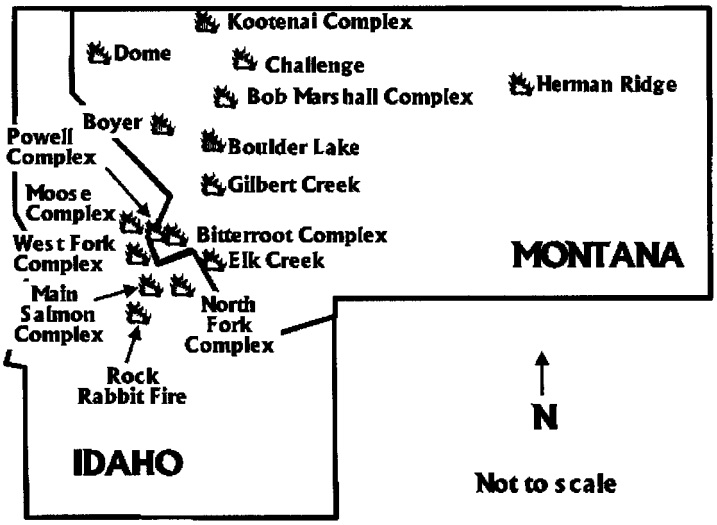

Figure 2

Wildland fire activity in Idaho and Montana from August to September 1998.

Individual fires ranged in size from less than one-quarter acre to more than several thousand acres. Appropriate management responses were designed for each fire or for groups of fires through preparation of Wildland Fire Implementation Plans (WFIP) when resource benefits were the dominant objective. When protection objectives and/or external influences indicated an overriding need for a suppression-oriented response, either an initial attack response was originated or a Wildland Fire Situation Analysis (WFSA) was used to formulate the preferred strategic alternative.

After reviewing the various appropriate management responses applied to fires managed individually or in these seven complexes, it was possible to consolidate the various appropriate management responses into tactical groups. These groups include monitoring from a distance, monitoring on-site, confinement, monitoring plus contingency actions, monitoring plus mitigation actions, initial attack, large fire suppression with multiple strategies, and control and extinguishment. These appropriate management response groups are defined as:

- Monitoring from a distance - fire situations where inactive behavior and low threats required only periodic monitoring from a nearby high point, lookout, or aircraft.
- Monitoring on-site - fires where circumstances required the physical placement of monitors on the fire site to track movement and growth.
- Confinement - actions taken when wildland fires were not viable candidates for resource benefits and an analysis of strategic alternatives indicated threats from the fire did not require costly deployment of large numbers of suppression resources for mitigation or suppression. These fires were managed with little or no on-the-ground activity and fire movement remained confined within a pre-determined area bounded by natural barriers or fuel changes.
- Monitoring plus contingency actions - monitoring was carried out on fires managed for resource benefits but circumstances necessitated preparation of contingency actions to satisfy external influences and ensure adequate preparation for possible undesirable developments.
- Monitoring plus mitigation actions - actions on fires managed for resource benefits that either posed real, but not necessarily immediate, threats or did not have a totally naturally defensible boundary. These fires were monitored, but operational actions were developed and implemented to delay, direct, or check fire spread, or to contain the fire to a defined area, and/or to ensure public safety (through signing, information, and trail and area closures).
- Initial attack - situations where an initial response was taken to suppress wildland fires, consistent with firefighter and public safety and values to be protected.
- Large fire suppression with multiple strategies - categorizes fires where a combination of tactics such as direct attack, indirect attack, and confinement by natural barriers were used to accomplish protection objectives as directed in a WFSA.
- Control and extinguishment - actions taken on fires when a WFSA alternative indicated a control strategy using direct attack was preferred. Sufficient resources were assigned to achieve control of the fire with minimum burned area.

The purpose of aggregating fires into these groups is not to create discrete types of appropriate management responses or a new classification of responses. It is strictly a single purpose effort of further exemplifying the dynamic, full range of appropriate management responses. These groups do not necessarily represent all possibilities and may not be applicable to all wildland fires. They do, however, provide a useful description of the range of appropriate management responses implemented during the wildland fire activity experienced from August to September 1998 in the Northern Rocky Mountains. Because of the high number of wildland fires managed during this period, it is difficult and repetitive to describe attributes of each individual appropriate management response. Describing groups of like responses is useful because it provides more concise, understandable information such as summaries of fire information, objectives, and management actions for each appropriate management response group, reduces redundancy, and offers a clear image of the fire situations and subsequent management activities *(table 2)*.

As land use changes from wilderness to non-wilderness and multiple use direction, objectives for fire management also generally change *(table 2)*. This strongly influences the dynamics of appropriate management responses. However, responses are not limited to one particular kind because of land use. For example, wildland fires in wilderness are not only subject to monitoring for resource benefits. One wildland fire in the wilderness area on the Powell Complex received a suppression response to achieve control. This was the appropriate management response based on the full array of considerations. In addition, within specific primary land uses, increasing threats drive appropriate management responses to include greater on-the-ground activity *(table 2)*. Fire size and activity also demonstrate a major influence on the appropriate management response.

Numbers of fires can also be grouped by strategic response groups by complex to illustrate differences in appropriate management responses within each complex *(table 3)*. Some complexes principally focused on implementation of various levels of monitoring actions while the attention of others was devoted to tactical implementation in support of critical protection objectives *(table 3)*.

Costs of Appropriate Management Responses for Managing Wildland Fire

Under the previous fire policy, all wildland fires were considered as either wildfires or prescribed fires. Fires managed for resource benefits as prescribed natural fires were designated as part of the prescribed fire category. Because wildfires and prescribed natural fires were of different designation, cost comparisons between them logically developed. Under the new policy, all of these fires are considered wildland fires. Comparing costs among wildland fires does not lend itself to a meaningful analysis.

A review of costs for appropriate management responses can provide a useful contrast. This contrast demonstrates how dynamic appropriate management responses must be to respond to the range of fire situations and objectives. As appropriate management responses shift along the scale, management activity and costs will also react accordingly, but not necessarily linearly. Assuming managing fire for resource benefits and suppression to be strategic extremes of the appropriate management response spectrum, it can be expected that costs of both will vary considerably. Considerations associated with these strategic options such as the philosophy, objectives, and temporal considerations generate a considerable difference in management action focus, strategy, and tactics along the full range of appropriate management responses from one extreme to another *(table 4)*. These factors all interact to cause widely variable costs.

Table 2-*Descriptions of fire situation and management actions for strategic groupings of wildland fires in the Northern Rocky Mountains, 1998.*

Strategic fire grouping	Fire situation and management action descriptors							
	Size	Fire activity	Threats	Primary objectives	Management organization needs	On-the-ground activity	Primary land use	Expected cost level
Monitoring from a distance	Small	Inactive	L[1]	Resource benefits	FUMT/Local[2]	L[1]	Wilderness/ National Park	L[1]
Monitoring on -site	Small -- moderate	Inactive -- active	L -- M	Resource benefits	FUMT/Local	L	Wilderness/ National Park	L
Confinement	Small -- large	Inactive -- active	L	Protection	FUMT / Local	L	Wilderness/ National Park	L
Monitoring plus contingency actions	Small -- large	Inactive -- active	L -- M	Resource benefits	FUMT/ Local	L - M	Wilderness /National Park	L
Monitoring plus mitigation actions	Moderate -- large	Active	M -- H	Resource benefits	FUMT /Local	L - H	Wilderness/ National Park	L - M
Initial attack	Small	Inactive -- active	L -- H	Protection	FUMT /Local / IMT	L - M	Wilderness	M - H
Large fire suppression - multiple strategies	Moderate -- large	Active	M -- H	Protection	IMT / Local	M - H	Multiple use	H
Control - extinguishment	Large	Active	H	Protection	IMT/Local	H	Wilderness /Multiple use	H

[1] L = low, M = moderate, H = high
[2] FUMT = Fire Use Management Team, IMT = Incident Management Team

Table 3-*Summary of numbers of fires per appropriate management response grouping for wildland fire complexes, Northern Rocky Mountains, 1998.*

Strategic fire grouping	Wildland fire complex							
	Rock Rabbit	Kootenai	Moose	West Fork	Main Salmon	Powell	North Fork	Bitterroot
Monitoring from a distance	1	1	4	9	8	3	--	--
Monitoring on-site	--	--	--	--	--	--	--	--
Confinement	--	--	--	4	6	2	--	--
Monitoring plus contingency actions	--	--	2	1	4	--	--	--
Monitoring plus mitigation actions	--	1	2	1	2	1	--	--
Initial attack	--	--	--	--	4	--	7	--
Large fire suppression - multiple strategies	--	--	--	--	--	--	1	--
Control - extinguishment	--	--	--	--	--	1	1	2

The goal of the new policy is not to force managers to select the least cost response but to let management and protection objectives guide selection of the most cost effective and efficient response to each wildland fire. The term "appropriate management response" does not and will not automatically translate to a wholesale decrease in wildland fire management costs in the future. Appropriate management responses to fires will reflect the correct action for a given situation. The likelihood exists that many future responses for a given situation will be different than for the same situation a few years ago (for example, the proportion of wildland fires managed for resource benefits in 1998 versus the proportion that would have received suppression responses a few years earlier). The likelihood also exists that for some specific situations, responses will never change. Costs of future management responses will show change, but these changes may present both lower and higher costs of fire management. Costs of responses to achieve different objectives will not show clear differentiation. Managing fires to achieve resource benefits will, for some fires, cost very little. In other cases, implementation of long duration wildland fire use actions on some fires could result in greater costs than if an immediate suppression had been implemented. A consideration necessary to evaluate immediate costs of wildland fire use is the fact that both short- and long-term effects of appropriate management responses are important. It is relatively easy to understand the short-term benefits realized from wildland fire use, but long-term gains are harder to comprehend and quantify. The value of restoration of fire as a natural process, reduction of hazard fuels, restoration of historic fire regimes and fuel complexes, effects on future wildland fire spread rates and intensities, and effects on future wildland fire suppression costs is hard to relate over a short time period. But these are major long-term goals worthy of substantial initial investments. The new policy established opportunities to realize a long-term return from managing fire for resource benefits that more than offsets any increased short-term costs.

Table 4-*Comparison of fire management considerations for wildland fire objectives of protection and resource benefits.*

Fire Management Consideration	Protection	Resource Benefits
Philosophy	Realize benefits from fire absence	Realize benefits from fire presence
Objectives	Protection objectives - suppression actions	Resource benefit objectives - fire use actions
Temporal considerations	Short-term focus	Long-term focus
Management action focus	Tactical operations, development of operational plans and identification of control line locations, short-term fire-growth projection, support Wildland Fire Situation Analysis decisions, suppression implementation actions.	Strategic planning, development of implementation plans and ultimate acceptable fire areas, long-range assessment, long-term fire-growth projection, support fire use decision-making, fire use implementation actions.
Strategy	Minimize loss	Maximize benefits
Tactics	Direct attack, necessary organization may become large	Monitoring plus required scale of combination of tactics to stop, direct, delay, or check fire spread; necessary organization remains small
Management Environment	Supportive, perception of low risk situation (high threat situation), outcome relatively certain, readily accepted.	Cautious, perception of high risk (low threat situation), outcome commonly uncertain or difficult to envision, associated uncertainty makes acceptance difficult.
Public Environment	Supportive, certain of purpose and actions.	Contentious, uncertain of purpose, actions, and outcome.

Substantial commitments of resources to control and extinguish fires and accomplish suppression objectives will result in the highest costs, often significantly higher than costs for most other management actions. Regardless of the final cost figures, fires managed through an appropriate management response received the best management direction, and costs were likely commensurate with considerations surrounding the fire situation and objectives to be accomplished.

Wildland fire costs are primarily comprised of personnel and equipment costs and support to tactical implementation. Generally, the proportional input to total costs ranks personnel highest, then equipment, and then support. As the appropriate management response moves along the gradient from monitoring to control and extinguishment, the required levels of personnel, equipment, support, on-the-ground activity, and management organization increase *(table 2)*. This increased activity along the appropriate management response gradient generally, but not always, translates into increases in total costs.

Increasing numbers of fires managed by a single management organization and application of differential response strategies made it difficult to impossible to track costs on an individual fire basis. Neither cost tracking nor apportionment among fires were completed for each and every fire. Instead, costs were documented as totals for each complex. Total area burned, total costs, and cost

per acre information were determined for the seven wildland fire complexes in the Northern Rocky Mountains *(table 5)*. The Rock Rabbit Fire figures represent a single fire and not a complex.

Managing fires for resource benefits does not always result in the lowest costs from a short-term perspective *(table 5)*. When the correct appropriate management response was applied, that fire management action resulted in a defined set of costs *(table 5)*. In some cases, the appropriate management response may have generated costs greater than expected. For given scenarios, costs of long-term monitoring plus additional management actions may begin to approach suppression costs.

Cost figures must be interpreted cautiously *(table 5)*. How costs were accrued were not clear for figures representing aggregate costs for a complex. The costs per acre figures are merely an arithmetic output and do not offer a true picture of the cost for each acre managed in the complex.

The Main Salmon Complex can be used to illustrate limitations associated with a single cost/ acre figure for a complex. In the Main Salmon Complex, 24 fires were managed *(table 3)*. Of these, eight were monitored from a distance with the only costs resulting from periodic aircraft overflights. Area burned by these fires was managed for relatively low costs. Conversely, the two fires managed with monitoring and mitigation actions necessitated placement of multiple crew resources (20 - 50 personnel at varying periods) to install structure protection equipment, set up and test a water delivery system, plan and complete a boundary strengthening burnout operation, monitor daily fire spread, behavior, and weather, patrol boundary areas, and enforce area closures to maintain maximum public safety. These fires accumulated costs from daily aircraft overflight and mapping, and equipment, supply, and personnel delivery, as well as necessary support. The implication to the complex cost figure is that these two fires could have accounted for as much as 50 percent of the Main Salmon Complex costs, while a greater number of fires in the complex, with more acres burned, could have accounted for a lower proportion of costs and a markedly lower cost per acre figure. Further inflation of costs for the complex occurred from interregional and interstate coordination activities with Idaho and Montana State Departments of Environmental Quality to monitor and model smoke production and dispersal. Although efforts were concentrated in the Salmon area, they monitored and affected all fires and complexes. However, all activity costs were included in the Main Salmon Complex figures, rather than amortized over all fires.

Thus, for this as well as all complexes, it can be confirmed that while the total cost figure is an accurate representation of the expenditures necessary to accomplish objectives for all fires in the complexes, the cost per acre figures do not completely portray the costs of managing each individual fire. The Rock

Table 5-*Summary of area burned and costs for wildland fire complexes, Northern Rocky Mountains, 1998.*

Wildland Fire Complex	Area burned (acres)	Total cost ($)	Cost per acre ($)
Rock Rabbit	7,198	23,566	3
Kootenai	9,500	650,000	74
Moose	1,654	378,000	228
West Fork	8,937	470,000	54
Main Salmon	21,650	1,137,000	52
Powell	5,223	229,300	44
North Fork	7,223	5,206,000	721
Bitterroot	4,090	2,098,000	513

Rabbit Fire does provide an indication of tracked costs for an individual fire and is certainly representative of the area along the appropriate management response spectrum generating the lowest costs.

Within the seven complexes, it can be assumed that cost of managing each fire increased as the on-the-ground activity levels increased. Implementation of mitigation actions requires tactical deployment of personnel and their support. Costs for this type of activity will exceed those for situations where monitoring is the single tactical operation.

At the other end of the appropriate management response spectrum, the North Fork and Bitterroot Complexes consisted of fires only receiving suppression-oriented appropriate management responses *(table 2)*. These fires posed greater threats, were located in areas where fire presence was undesirable, and necessitated large resource commitments and on-the-ground activity. Consequently, costs appear very high, but given the location, situation, and objectives, the costs reflect the expense of implementing the necessary appropriate management response. It can be assumed that any other response would not have achieved the objectives as well or as cost-efficiently. The personnel and equipment needs necessary to accomplish objectives in these complexes are much higher than for any other appropriate management response shown. This is the single most important factor contributing to elevated costs for these complexes.

Further interpretation of the differences in appropriate management response costs can be gained by reviewing costs per day for the various fires and complexes. Fire management considerations show great variation for different aspects of the appropriate management response spectrum *(table 4)*. Specifically, temporal considerations are dramatically different. Implications of this difference are illustrated by the Main Salmon and North Fork Complexes. On the Main Salmon Complex, fires were managed by a formal management organization for 39 days while fires in the North Fork Complex were managed by a formal management organization for 26 days. Costs to accomplish the Main Salmon Complex objectives averaged about $26,600 per day and the North Fork Complex costs averaged nearly $200,200 per day. After transition from the management teams to the local unit, the Main Salmon Complex fires continued to burn until extinguished by weather. The North Fork Complex fires were extinguished along their perimeters but experienced some interior burning until extinguished by weather.

This huge disparity in daily costs reflects the magnitude of the on-the-ground activity, the scale of resources needed to accomplish the objectives, and the seriousness of the threats from the fires. In each case, the management response was appropriate to the situation and accomplished desired objectives. At the other end of the scale, the Rock Rabbit Fire was managed throughout its entirety by local unit forces. Costs of this fire reflect a lower, but constant, level of attention and scrutiny for over 50 days, which equates to about $470 per day.

Conclusions

As Federal agencies fully implement the 1995 Federal Wildland Fire Management Policy, implementation opportunities and varied accomplishments will broaden. The concept of applying an appropriate management response to every fire rather than standardizing responses by designated fire types will promote greater efficiency. Reflected in this enhanced efficiency will be greater attention to ecological concerns, greater responsiveness to resource management objectives, greater ability to accommodate evolving objectives, more effective assignment and use of limited resources, and the most efficient expenditure of funds.

Evaluating costs of implementing appropriate management responses has mixed relevancy. Comparing costs incurred under the new policy procedures with those generated during implementation of procedures under the old policy

does not provide a valid or useful comparison. The costs per acre of managing fires with different strategies within a single complex, or of managing a single large fire with several different strategies concurrently, cannot be directly compared with the cost/acre under previous response strategies.

Contrasting costs along the full range of the appropriate management response spectrum will provide a more meaningful evaluation. Because of the disparity in requirements for accomplishing differing objectives, comparisons of specific objectives, strategies, and costs within wildland fire management are also limited in value. There will not be a well-defined break between various fire management strategies; similar tactics of different scales will be applied to accomplish different objectives. As a result, costs of wildland fire management will vary considerably and managing fires for resource benefits will generally be lower than costs of suppressing fires for protection objectives. However, numerous situations will occur in which suppression costs will be lower than those for fire use applications.

As the new policy becomes fully implemented and agencies' expertise and experience in implementing appropriate management responses grows, baseline data will be established for future evaluations of program efficiency and effectiveness. The 1998 fire season in the Northern Rocky Mountains provided a thorough test of the new policy. During this period of activity, the soundness of appropriate management response was demonstrated while the dynamic nature presented by the range of tactical options available, the variety in implementation actions utilized, and the range of variability of costs within groups of similar appropriate management responses were obvious. Costs of implementing appropriate management responses in the future may not result in wholesale reductions in expenditures, but should show reductions in some areas. Whether the costs increase or decrease, at least they will exhibit a more logical relationship to resource benefits and values protected than was evident under previous suppression-oriented strategies. The 1998 fire season activity will provide a foundation for future evaluation and continued improvements to the wildland fire management program and will facilitate accomplishment of the complete array of management objectives.

Acknowledgments

I would like to thank Tom Goheen, Salmon National Forest; Jack Kirkendall, Bitterroot National Forest; Byron Bonney, Nez Perce National Forest; Nikki Dyke, Payette National Forest; Fred Vanhorn, Glacier National Park; and Bill Adams, National Interagency Fire Center, for their help in assembling fire cost data. I also thank Steve Botti and Dave Bunnell, National Interagency Fire Center, for their review of the manuscript and helpful suggestions.

References

U. S. Department of the Interior/U. S. Department of Agriculture. 1995. **Federal wildland fire management policy and program review.** Final Report. Boise, ID: National Interagency Fire Center; 45 p.