National Park Service
U.S. Department of the Interior

Yellowstone National Park

2004 Update of the 1992 Wildland Fire Management Plan

2004 Update of The
Yellowstone National Park
1992 Wildland Fire Management Plan

Yellowstone National Park
Intermountain Region
National Park Service
Department of the Interior

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I. INTRODUCTION

Yellowstone National Park (Yellowstone or park) encompasses 2,221,772 acres (3,472 square miles) and is located primarily in the northwest corner of Wyoming, with portions extending into southwestern Montana and southeastern Idaho (Figure 1) It is the core of the Greater Yellowstone Area (GYA), an approximately 12 million- acre area that includes Grand Teton National Park and John D. Rockefeller, Jr. Memorial National Parkway to the south, seven national forests, three national wildlife refuges, and additional Native American Indian reservations, state lands, towns and private property. The GYA is the largest and most nearly intact temperate ecosystem in the contiguous United States (Figure 2).

The National Park Service (NPS) Director's Order #18: *Wildland Fire Management* (DO- 18) U.S. Department of Interior (USDI 2003) and supporting Reference Manual #18: *Wildland and Prescribed Fire Management Policy* (RM- 18) (USDI 1999*a*) require that "every park area with burnable vegetation must have a fire management plan approved by the Superintendent." Yellowstone has operated under a 1992 wildland fire management plan (FMP) (Appendix A) for which an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for compliance with the National Environmental Policy Act of 1969 (NEPA) were approved by the NPS Intermountain Region in 1992.

Human fatalities during the 1994 fire season and the escape of the Cerro Grande prescribed fire in New Mexico in 2000 resulted in the 1995 and 2001 Federal Wildland Fire Management Policy Review and Updates (USDA/USDI 1995, USDA/USDI 2001). These documents recognized the role of fire as a critical natural process and made recommendations for improvements in fire planning, hazardous fuels reduction within the Wildland- Urban Interface (WUI), interagency coordination and cooperation, and program management and oversight.

A. Purpose for 2004 Update of the 1992 Wildland Fire Management Plan

An update of the 1992 FMP (2004 Update) is required for Yellowstone to manage wildland fire in accordance with the 1995 and 2001 federal fire policies, the 1998 Wildland and Prescribed Fire Management Implementation Procedures Reference Guide (*Implementation Guide*) (Zimmerman and Bunnell 1998), NPS 2001 Management Policies (USDI 2001), Interagency Standards and Fire Aviation Operations Manual NFES 2724 (*2004 Red Book*) (National Interagency Fire Center 2004), and guidelines under NPS DO- 18 and RM- 18. These policies and directives require an approved FMP for a national park to use resource benefit as a primary consideration in selecting among fire management strategies.

Yellowstone National Park
MT, WY, ID

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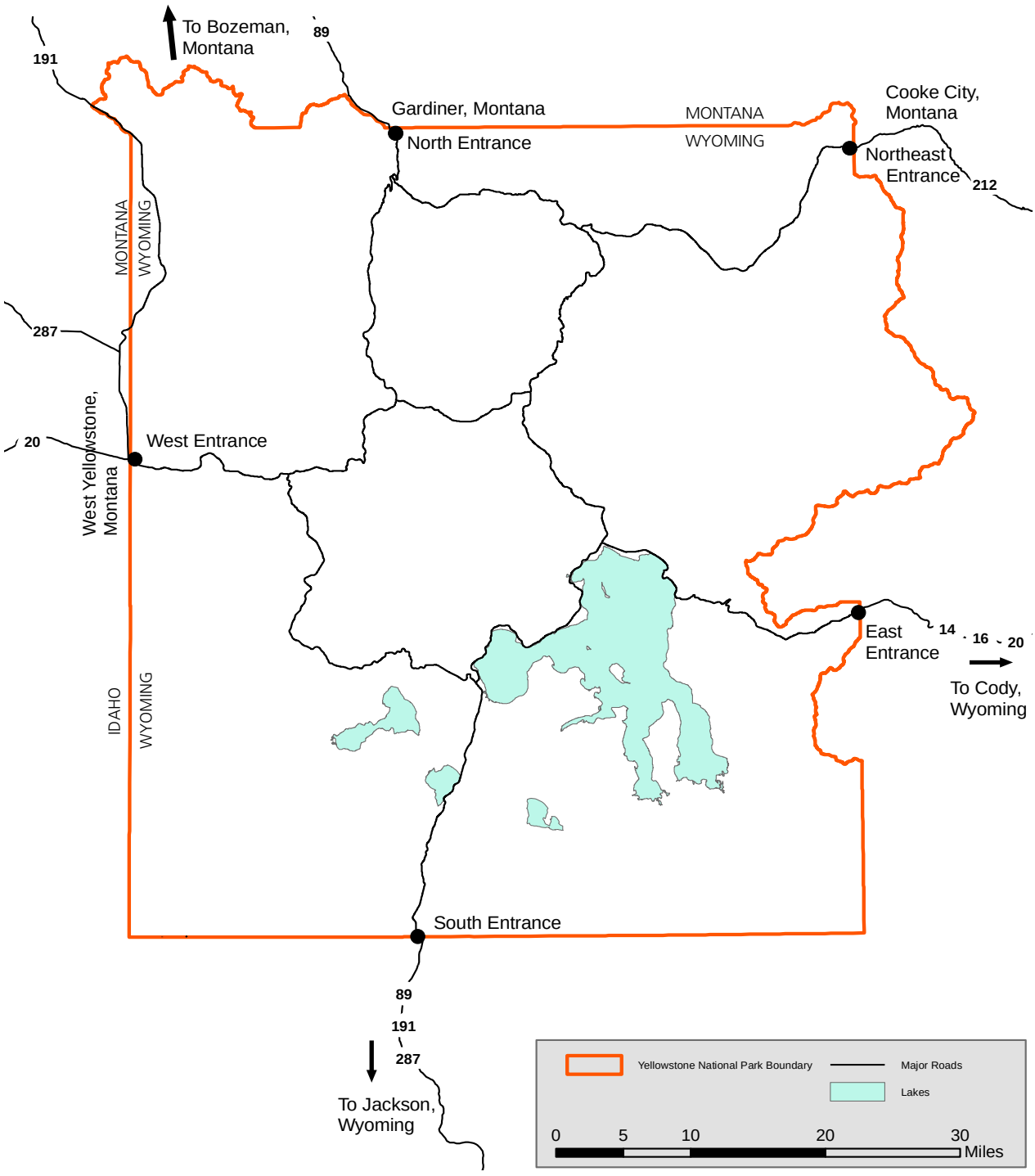
Figure 1. Yellowstone National Park



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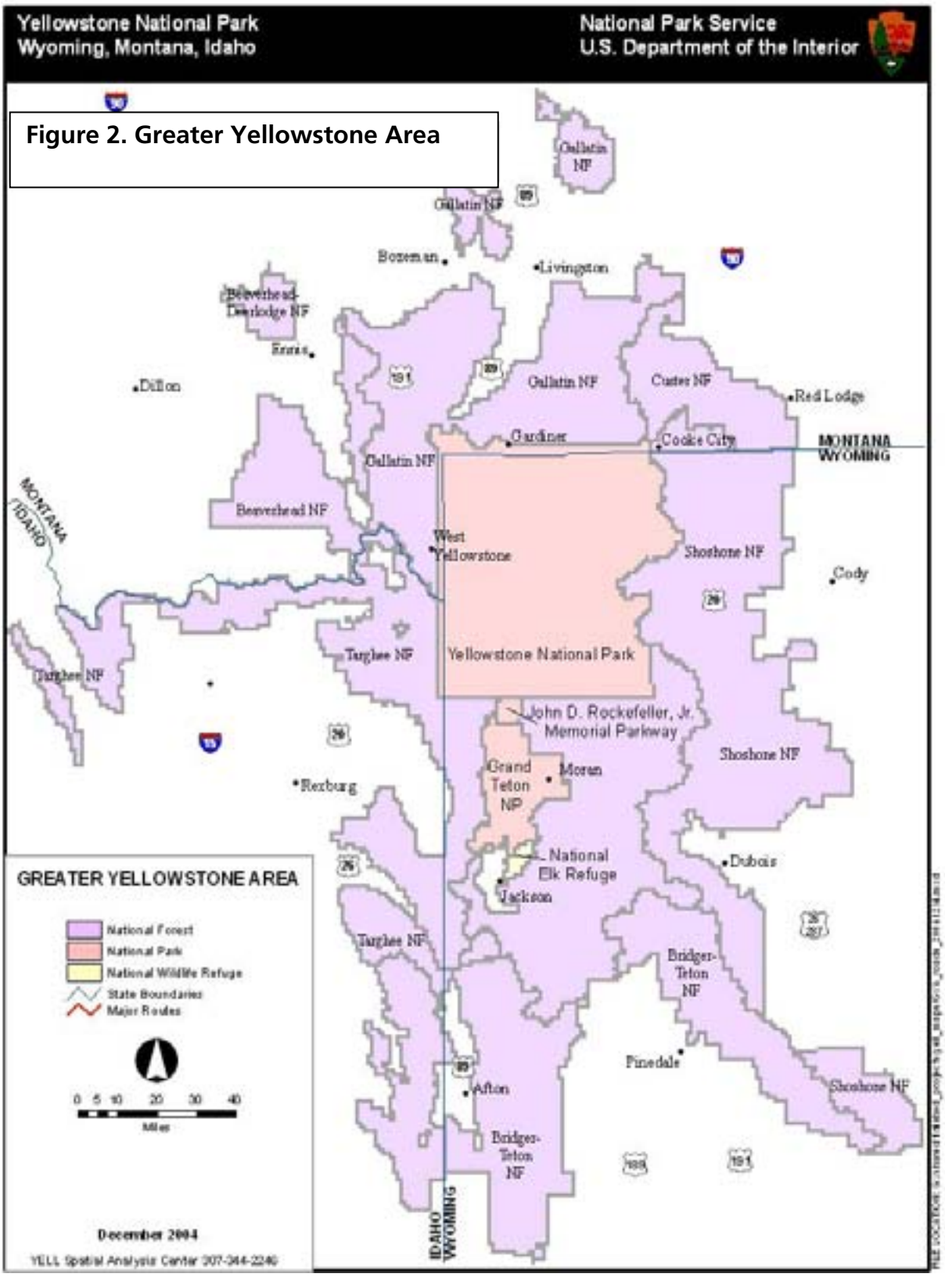

Yellowstone National Park
Wyoming, Montana, Idaho
National Park Service
U.S. Department of the Interior
Figure 2. Greater Yellowstone Area
Gallatin NF
Bozeman
Livingston
Beaverhead-Deerlodge NF
Ennis
Dillon
Gallatin NF
Custer NF
Red Lodge
Gardiner
Cooke City
MONTANA
WYOMING
Gallatin NF
Beaverhead NF
MONTANA
IDAHO
West Yellowstone
Shoshone NF
Cody
Targhee NF
Yellowstone National Park
Targhee NF
John D. Rockefeller, Jr. Memorial Parkway
Shoshone NF
Rexburg
Grand Teton NP
Moran
National Elk Refuge
Jackson
Dubois
Targhee NF
Bridger-Teton NF
Pinedale
Shoshone NF
Afton
Bridger-Teton NF
IDAHO
WYOMING
GREATER YELLOWSTONE AREA
National Forest
National Park
National Wildlife Refuge
State Boundaries
Major Routes
0 5 10 20 30 40
Miles
December 2004
YELL Spatial Analysis Center 307-344-2246

The 2004 Update replaces the 1992 FMP by incorporating the following components:

- 2004 *Red Book*;
- Revised decision- making process, terminology, and format based on the *Implementation Guide* and the 1995 and 2001 Federal Wildland Fire Management Policy and Program Reviews;
- Redrawing of the management zones into seven fire management unit boundaries to facilitate interagency fire management planning and the new interagency Fire Program Analysis fire budget process; and
- 2001 *Yellowstone National Park Structure Protection and Firefighter Safety Hazard Fuels Management Guidelines*.

The implementation of the 2004 Update will allow fire to continue to play its ecological role in the park while protecting human life, developments, and sensitive cultural and natural resources. The decision- making process includes specifically managing wildland fire using best available technology to maintain ecosystem processes, and the use of resource information gained through inventory and monitoring to evaluate and improve the wildland fire management program. Definitions of terminology used in this update are contained in Appendix B.

B. History of Wildland Fire Management in Yellowstone National Park

Archeological records show that humans have occupied the Yellowstone Plateau for more than 11,000 years (Haines 1977). Excavations have revealed that early humans throughout North America used fire for agriculture, food gathering, hunting, and warfare. Wildland fires in the Yellowstone area were first recorded in European expeditions to the area from 1869- 1872. These accounts described the mosaic patterns left by earlier fires and reported large fires burning in various areas of the park. Other excerpts from Superintendent reports stated that many fires were started by lightning. Fires closer to the developed areas appeared to be caused by humans. These fires most likely resulted from campfires left unattended by park visitors, hunters attempting to drive game from the park, or abandoned warming and cooking fires.

In the 1870s, the interpretation of Yellowstone's enabling legislation was to preserve and protect park resources. Many of the fires originated along the travel routes used at that time. While most of them remained small, early fire management policy in the park resulted in suppressing all fires in these areas to "save the forests."

The Leopold Report (Leopold et al. 1963) signaled a change in NPS attitude and policy concerning fire's role in the environment in the early 1960s. This report suggested that natural areas in the national park system be managed to create a reasonable illusion of primitive America and to maintain the biotic associations that prevailed when each area was first visited by white man. The report attempted to explain the important and dynamic role that natural fire plays in an ecosystem. As

part of a management strategy, the changes caused by fire could improve the health of the natural environment and increase its diversity.

In 1972, Yellowstone responded to the policy changes initiated by the Leopold Report by preparing a "natural" fire management policy to allow certain naturally-ignited fires (e.g, lightning) to burn. This plan designated 340,784 acres in two backcountry regions of the park as natural fire zones: the Mirror Plateau and Two Ocean Plateau. Ten fires burned a total of 831 acres in the fire seasons of 1972, 1973, and 1974. The successful experience of these fire seasons led to the revision of the plan to expand the natural fire zone to include most of the park, with the exception of developed areas and a buffer zone around the park boundary.

The revised plan and an EA under NEPA were approved and implemented in 1976. The 1976 plan remained in effect until suspended in July 1988 as a consequence of the 1988 fire season in Yellowstone. In 1992, Yellowstone completed a new FMP based on the three integrated strategies of *suppression*, *prescribed natural fire*, and *management- ignited natural fire* under which the park has operated until completion of the 2004 Update.

C. Collaborative Processes

Collaborative processes include interagency fire management planning with Grand Teton National Park and the six adjoining national forests under the direction of the Greater Yellowstone Coordinating Committee based on the *Greater Yellowstone Area Interagency Fire Management Planning and Coordination Guide* (*2000 GYCC Guide*) (Appendix C). This guide is expected to be re- evaluated during 2005. In addition, the park has an agreement with the South Central Zone in the Northern Rockies.

D. Achieving Resource Management and Fire Management Goals Through Implementation of Fire Management Policies

The 2004 Update will implement fire management policies and help achieve resource management and fire management goals as defined in the following documents:

1995 Federal Wildland Fire Management Policy and Program Review
(USDA/USDI 1995)
The Secretaries of the Department of Agriculture and Department of Interior convened this review after the 1994 fire season to reaffirm and ensure that cooperative interagency and intergovernmental fire management programs would continue. The 1995 report provided nine guiding principles and recommended 13 Federal wildland fire policies in areas of safety, planning, wildland fire, prescribed fire, preparedness, suppression, prevention protection priorities, interagency cooperation, standardization, economic efficiency, wildland- urban interface, and administration and employee roles.

2001 Federal Wildland Fire Management Policy and Program Review and Update (USDA/USDI 2001)
The Interagency Federal Wildland Fire Policy Review Working Group, at the direction of the Secretaries of the Interior and Agriculture, reviewed the 1995 Federal Wildland Fire Management Policy and Program Review and its implementation. The working group found that the policy continued to provide a solid foundation for wildland fire management activities and for natural resources management activities of the federal government. The 2001 Federal Wildland Fire Management Policy and the *Implementation Guide* replace the 1995 Federal Wildland Fire Policy.

National Fire Plan (USDA/USDI 2000)
The National Fire Plan goals and guiding principles are to improve fire prevention and suppression, reduce hazardous fuels, restore human- altered fire- adapted ecosystems, and promote community assistance. The National Fire Plan addresses five key points: firefighting, rehabilitation and restoration, hazardous fuels reduction, community assistance, and accountability. The National Fire Plan states that "Fuels management activities will incorporate treatments necessary to change the stand condition class (which reflects the level of damage that would result from a wildland fire on those lands) from a higher risk condition class to lower risk and to maintain those areas in which a desirable condition class has been established." In addition, fuels management activities focus on hazardous fuels reduction in WUI areas that have been identified by community- based collaborative efforts with a goal of reducing risk to life and property.

Managing Impacts of Wildfires on Communities and the Environment and Protecting People and Sustaining Resources in Fire Adapted Ecosystems—A Cohesive Strategy (USDA/USDI 2000)
In August 2000, President Clinton issued a memorandum of action to the Secretaries of Agriculture and Interior to assess the impacts of wildland fires on rural communities. The President directed the Secretaries to prepare a report of recommendations for responding to the fires of 2000, reducing the impacts of these fires on rural communities, and ensuring sufficient firefighting resources for the future.

A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10- year Comprehensive Strategy (USDA/USDI 2001) **and** ***A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10- year Comprehensive Strategy: Implementation Plan*** (USDA/USDI 2002)
In August 2001, the Secretaries of Agriculture and Interior joined the Western Governors' Association, the National Association of State Foresters, the National Association of Counties, and the Intertribal Timber Council to endorse these documents. This collaborative strategy marked the initial fulfillment of two key Congressional directives whereby the Secretaries of Interior and Agriculture and the Governors jointly develop a long- term national strategy to address wildland fire and

hazardous fuels, along with restoration and rehabilitation needs. This strategy is to be developed with "close collaboration among citizens and governments at all levels."

E. Compliance with Federal Laws

1. National Environmental Policy Act of 1969 (NEPA)

An EA was completed for Yellowstone's 1992 FMP and a FONSI was signed by the Superintendent in 1992 (Appendix D) for compliance with NEPA. The preferred alternative in the EA identified three integrated strategies for wildland fire management– suppression, prescribed natural fire, and management- ignited natural fire–in three management zones: *suppression*, *conditional*, and *prescribed natural fire*. The new terminology for these three strategies is *wildland fire suppression*, *wildland fire use (WFU)*, and *prescribed fire*. The three zones have been delineated into seven fire management units (FMUs) under the 2004 Update and are described in section III,D. The three fire management strategies contained in the 1992 FMP remain essentially the same for the 2004 Update with some revisions in the decision- making process.

The 2004 Update incorporates the 1992 FMP, EA, 2001 *Yellowstone National Park Structure Protection and Firefighter Safety Hazard Fuels Management Guidelines* (Appendix E), and the 2004 *Yellowstone National Park Aviation Operations Management Guidelines* (Appendix F) in their entirety. Because the 2004 Update is considered a minor amendment to a previously approved plan, it is categorically excluded from further NEPA analysis based on NPS Director's Order 12 (DO- 12), section 3.4(B)(1). None of the exceptions to the use of a categorical exclusion stated in section 3.5 of DO- 12 apply to the 2004 Update. The categorical exclusion applies to the wildland fire suppression and WFU components of Yellowstone's fire management program. Although the procedures for prescribed fire and WUI hazardous fuel reduction projects are discussed in the 2004 Update, any prescribed fire or WUI project proposed in the future will undergo separate analysis for compliance under NEPA.

The timeframe of the 2004 Update and NEPA compliance are generally anticipated to be valid for the next ten to fifteen years, provided there are no significant changes in fire management policy, no significant changes in the park's resource objectives or desired future conditions (DFCs), and research does not warrant a change in fire management strategies.

2. National Historic Preservation Act of 1966

In 1992, the Wyoming, Montana, and Idaho State Historic Preservation Offices reviewed the 1992 FMP for compliance with Section 106 of the National Historic Preservation Act of 1966 (16 USC 470 *et seq*.) (NHPA). The Idaho State Historic Preservation Office (IDSHPO) noted that fire could affect combustible materials

found at archaeological sites. The Montana State Historic Preservation Office (MTSHPO) recommended that the park take a more proactive approach to protect cultural resources during fire- related activities. The Wyoming State Historic Preservation Office (WYSHPO) concurred with the fire management goals for the protection of historic and prehistoric cultural resources; however, they recommended that the 1992 FMP include provisions for cultural resource inventories subsequent to fire activities where substantial ground cover were removed. Furthermore, if, during the implementation of this program, cultural resources were discovered or possibly affected, the resources should be protected, and the appropriate state historic preservation office notified.

In December 2004, Yellowstone requested concurrence of *No Adverse Effect* from implementation of the 2004 Update from the three SHPOs (Appendix G). The park received a concurrence of *No Adverse Effect* on historic properties from MTSHPO on December 29, 2004. The park received a concurrence of *No Adverse Effect* on historic properties from the IDSHPO on January 6, 2005; however, the IDSHPO noted that "National Register eligibility of properties can change over time and the park must ensure that the evaluation of any given property under consideration is a current one." The park received a letter of concurrence of *No Adverse Effect* from the WYSHPO on February 25, 2005. Appendix H contains copies of these concurrence letters.

3. Endangered Species Act of 1973

Informal Section 7 consultation under the Endangered Species Act of 1973 (ESA) (16 USC 1531 *et seq*.) with the U.S. Fish and Wildlife Service (FWS) was completed for the 1992 FMP. The FWS concurred in 1992 that the overall effects from the 1992 FMP would be beneficial to the threatened grizzly bear and at that time, endangered, bald eagle. The FWS requested that each future prescribed fire be reviewed for compliance with the Act.

Appendix I contains Yellowstone's February 2005 programmatic biological assessment and letter requesting a "Not Likely to Adversely Affect" concurrence from the FWS. The park received a letter of concurrence of *Not Likely to Adversely Affect* from the FWS for the threatened Canada lynx, grizzly bear, gray wolf, and bald eagle on March 29, 2005 (Appendix J).

F. Authorities for Implementation of the 2004 Update

The authorities for implementing the 2004 Update are found in the NPS Organic Act (16 USC 1, August 25, 1916), the 1976 Authorities Act (16 USC 1a), and are further clarified in the National Parks and Recreation Act of 1978, and delegations of authority in Part 245 of the Departmental Manual.

II. RELATIONSHIP TO LAND MANAGEMENT PLANNING AND FIRE POLICY

A. NPS 2001 Management Policies

The NPS 2001 Management Policies state that "the NPS will preserve the natural resources, processes, systems, and values of units in the national park system in an unimpaired condition, to perpetuate their inherent integrity and to provide present and future generations with the opportunity to enjoy them." These policies also state that NPS "will not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, it will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems."

Specific to fire management, the NPS 2001 Management Policies state that "naturally ignited fire is a process that is part of many of the natural systems that are being sustained in parks," and that "park fire management programs will be designed to meet park resource management objectives while ensuring that firefighter and public safety are not compromised."

B. Enabling Legislation and Purpose of Park

Yellowstone was created as the first national park in the U.S. in 1872 and has served as a symbol for establishing the 389 additional national park sites in the United States and national park systems in more than 140 countries around the world. In recognition of this significance, the United Nations Educational, Social, and Cultural Organization (UNESCO) named Yellowstone as the first American area to be designated as a Biosphere Reserve in 1972. In 1978, UNESCO designated Yellowstone as a World Heritage Site.

The mission of Yellowstone is rooted in and grows from the park's legislated mandate found in the Act of Congress, March 1, 1872: "To set apart a certain tract of land lying near the headwaters of the Yellowstone River as a public park." The 1872 Act is supplemented by many others, including: "An Act to protect the birds and animals in Yellowstone National Park, and to punish crimes in said park." May 7, 1894: "An Act for the protection of the public forest reserves and national parks…." February 6, 1905: "An Act to make additions to the Absaroka and Gallatin National Forests, and Yellowstone, and to improve and extend the winter feed facilities…." May 26, 1926: and "An Act to revise the north, northeast, and east boundaries of Yellowstone National Park…" March 1, 1929.

The park's mission statement is a synthesis of the legislative intent, purpose and significance as described below.

Legislative Intent

- Dedicate and set apart a public park or pleasuring ground for the benefit and enjoyment of the people.
- Provide for the preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition.
- Conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

Purpose

The world's first national park, Yellowstone:

- Preserves geologic wonders, including the world's most extraordinary collection of geysers and hot springs and the underlying volcanic activity that sustains them.
- Preserves abundant and diverse wildlife in one of the largest remaining intact wild ecosystems on earth, supporting unparalleled biodiversity.
- Preserves an 11,000- year- old continuum of human history, including the sites, structures, and events that reflect our shared heritage.
- Provides for the benefit, enjoyment, education and inspiration of this and future generations.

Significance

- The majority of the world's geysers, including Old Faithful.
- The core of the last large ecosystem in the lower 48 states still inhabited by every wild species present when Columbus reached the New World 505 years ago.
- The powerful evidence of human history, such as several hundred archeological sites, nearly one thousand historic structures, and six designated National Historic Landmarks—Old Faithful Inn, the Northeast Entrance Station, Obsidian Cliff, and the Norris, Madison, and Fishing Bridge Museums.

Mission Statement

> *Preserved within Yellowstone National Park are Old Faithful and the majority of the world's geysers and hot springs. An outstanding mountain wildland with clean water and air, Yellowstone is home to the grizzly bear, wolf, and free- ranging herds of bison and elk. Centuries- old sites and historic buildings that reflect the unique heritage of America's first national park are also protected. Yellowstone National Park serves as a model and inspiration for national parks throughout the world. The National Park Service preserves unimpaired these and other natural and cultural resources and values for the enjoyment, education, and inspiration of this and future generations.*

C. Parkwide Desired Future Conditions

The parkwide DFCs are based on the NPS 2001 Management Policies and the goals of Yellowstone's 1998 Resource Management Plan (RMP) (USDI 1998a). The goals of NPS 2001 Management Policies are to "understand, maintain, restore, and protect the inherent integrity of the natural resources, processes, systems, and values of the park and to allow this evolution of natural processes and species to continue, minimally influenced by human actions." The goal of the park's fire management program is to "conserve, perpetuate, and portray as a composite whole the indigenous terrestrial and aquatic wildlife, plants, the geology, and the scenic landscape." The intent is to maintain the park in as natural a condition as is possible and to hold human influence over the natural components of the ecosystem to a minimum. Periodic naturally- ignited fire is a necessary part of the Yellowstone ecosystem, as various plant and animal communities have coevolved in the presence of recurring fire. Using refined fire management techniques and incorporating research findings, Yellowstone will continue to allow natural fire to play its natural role while balancing the concerns for protecting life and property in and outside of the park.

The Resource Stewardship Plan based on NPS Director's Order 2- 1 is currently under development and will replace the RMP upon completion. The Resource Stewardship Plan will update natural and cultural resource objectives based on DFCs for the park, which will then serve as a basis for wildland fire management planning.

D. Objectives of the Resource Management Plan

The RMP documents the park's needs and programmed actions related to natural and cultural management goals and objectives. The stated goals are to "preserve the natural and cultural resources of Yellowstone and to allow natural processes and interactions between resources to occur with a minimum of human influence." The plan identifies objectives, staffing needs, and budgets for over 100 individual and integrated natural and cultural resource projects to achieve the park's stated goals.

E. The Role of the 2004 Update in Meeting the Objectives in the Resource Management Plan

The 2004 Update will enable the wildland fire management program to meet the natural and cultural resource objectives stated in the RMP. The following objectives for wildland fire management are stated in the RMP and are integral components of the 2004 Update.

- Manage WFU based on annual program reviews
- Use aggressive tactics to suppress wildfires
- Use standard fire suppression tactics that result in minimal impacts to park resources
- Complete rehabilitation of areas impacted by suppression activities

- Correlate data from completed fuels monitoring program with fire weather readings and use in ongoing program to determine fire danger on site
- Accomplish hazardous fuels reduction by thinning trees and understory vegetation at developed areas in the park
- Consider using prescribed fire to reduce hazardous fuels around developments and near park boundaries
- Cooperate with and support research on prescribed fire and other fire management topics
- Incorporate fire management plans and data into the park's GIS system

III. WILDLAND FIRE MANAGEMENT STRATEGIES

A. General Management Considerations

Consistent with the *2001 Federal Wildland Fire Management Policy and Program Review and Update*, all fires not ignited by park management for specific purposes are considered wildland fires. Each wildland fire will receive management actions appropriate to conditions of the fire, fuels, weather, and topography to accomplish specific objectives for the individual fire. These management actions, termed the appropriate management response (AMR), may vary from fire to fire and even along the perimeter of an individual fire in a way that ranges from aggressive suppression to managing the fire to accomplish resource benefits. No wildland fire will automatically be categorized as having a lower priority than others. The AMR will be selected after comprehensive consideration of the local situation, risk to firefighter and public safety, available funding, management objectives, values to be protected, external concerns, and land use concerns.

Wildfires are unplanned events and may not be used to achieve resource management objectives. All human- caused fires will be suppressed emphasizing safety to firefighters and sensitivity to park resources by using Minimum Impact Suppression Tactics (MIST) developed by the National Wildfire Coordinating Group.

As described in the *Implementation Guide*, each lightning- caused fire will be considered a candidate wildland fire use (WFU) and the Stage I form found in the Wildland Fire Implementation Plan (WFIP) will be completed for all fires. Wildland fires that meet all the conditions found in the Stage I analysis will be declared WFU fires and the Stage II portion of the WFIP will be completed within the required time frames. All fires that do not meet the conditions found in the Stage I analysis will be suppressed according to the most appropriate management strategy using MIST. A Wildland Fire Situation Analysis (WFSA) will be completed for all suppression fires that exceed initial attack, for all WFU fires that exceed the goals listed in the WFIP, and for all prescribed fires that exceed the prescription parameters listed in the prescribed fire plan. Wildland fire use requires more intensive planning and evaluation than wildland fire suppression actions and prescribed fires, especially at the initial decision point when the fire is detected.

Collaborative processes for fire management in the GYA include interagency fire management planning with Grand Teton National Park and the six adjoining national forests under the direction of the Greater Yellowstone Coordinating Committee based on the *2000 GYCC Guide*.

B. Wildland Fire Management Goals

The following wildland fire management goals are based on federal wildland fire policies and strategies, NPS 2001 Management Policies, DO- 18 and RM- 18, and Yellowstone's RMP:

- Firefighter and public safety is the first priority in every fire management activity
- Allow fire to play its ecological role in the park to the greatest extent possible through the use of appropriate management techniques
- Suppress wildfires in a safe, cost- effective, and environmentally sensitive manner
- commensurate with the values at risk
- Maintain an active fire prevention program
- Maintain a fully qualified fire management staff to implement a FMP
- Maintain an interpretive and public information program that will educate the public on the ecological role of fire in the park and provide daily fire danger and situation information

C. Wildland Fire Management Options

1. Suppression

This option includes all actions initiated to limit the growth of a wildfire. A *wildfire* is defined as a free burning and unwanted wildland fire requiring a suppression action. Wildfires will always be suppressed in the safest, most cost- effective manner, and with the least impacts to park resources possible, as required by interagency and NPS wildland fire policies.

2. Wildland Fire Use

Wildland fire use is a fire ignited by natural means (usually lightning) and permitted to burn under specific environmental conditions. The goal of WFU is to perpetuate natural processes. Each naturally- ignited fire will be allowed to continue burning as long as it remains within specified objectives for the fire as outlined in the WFIP. Wildland fires that exceed the WFIP objectives will be declared wildfires and the appropriate suppression response will be initiated.

3. Prescribed Fire

A prescribed fire is a fire ignited by park managers to achieve the park's resource management goals. Prescribed fire activities will include monitoring programs that record fire behavior, smoke behavior, fire decisions, and fire effects to provide information on whether specific objectives are met. Escaped prescribed fires will be declared wildfires and the appropriate suppression response will be initiated. Prescribed fires may be used in conjunction with non- fire (mechanical/manual) hazardous fuel reduction to burn accumulated fuels. Prescribed fires may also be conducted for research purposes.

4. Non-Fire Fuels Management Applications

Non- fire fuels management applications in Yellowstone include mechanical and manual thinning of trees and understory vegetation to reduce hazardous fuels accumulation around structures such as backcountry patrol cabins and within the wildland- urban interface of developed areas. The goals are to protect existing structures and improve firefighter and public safety by creating a "Safety Zone" near these developed areas should a wildland fire occur.

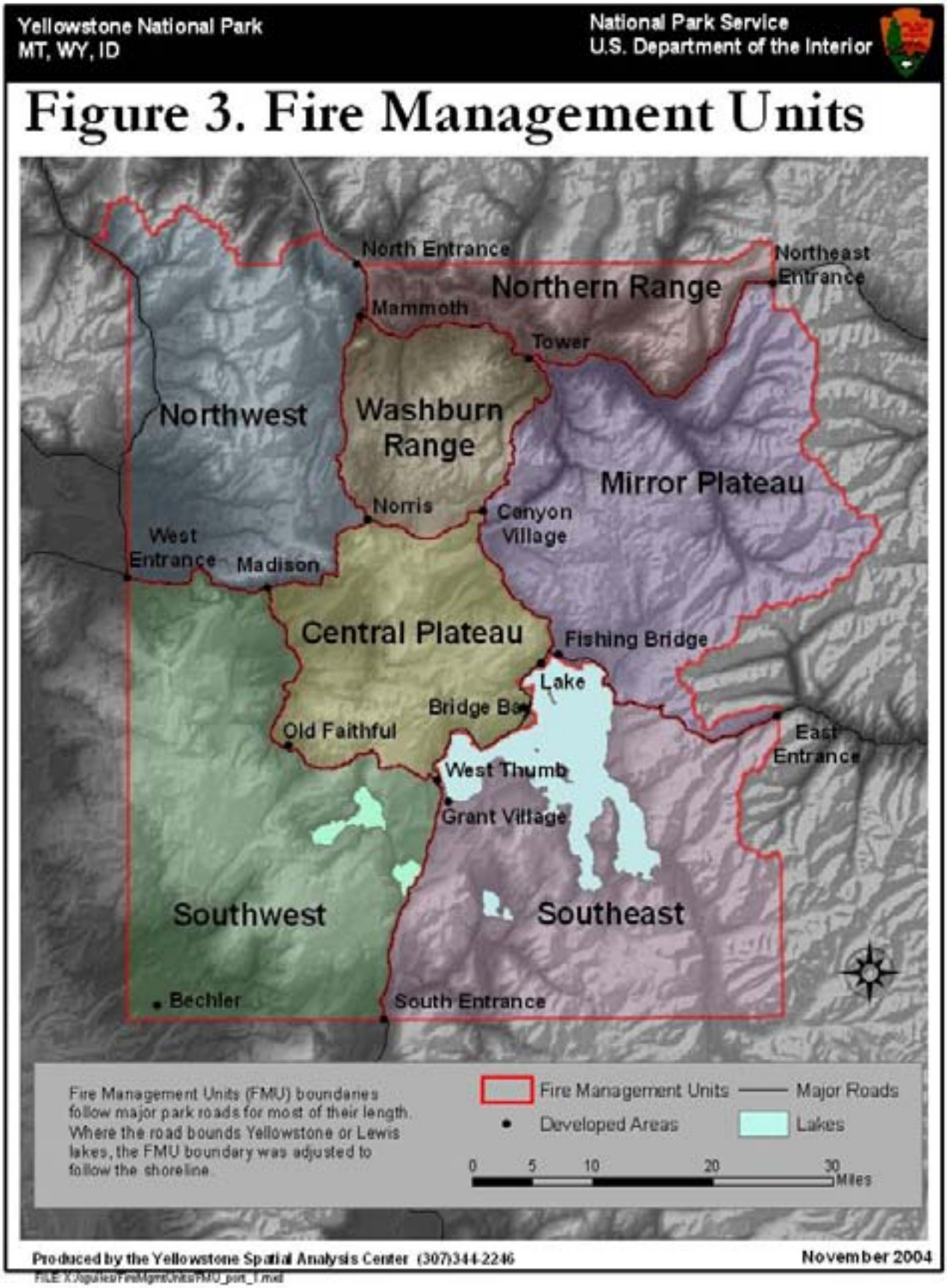
D. Description of Wildland Fire Management Options by Fire Management Unit

1. Fire Management Unit Identifier

The 2004 Update delineates the park into the following seven Fire Management Units (FMUs) using natural geographic features and boundaries, the park's paved road system, major rivers, lakes, drainage corridors, and ridge tops: Northern Range, Northwest, Washburn Range, Mirror Plateau, Central Plateau, Southwest, and Southeast (Figure 3).

a. Physical Description of the Fire Management Units

Information used to determine the number of burned and unburned acres in each FMU is based on perimeter mapping of fires larger than 100 acres from 1881- 2004. This mapping includes Superintendent and other reports from 1881- 1930; individual forest fire report forms from 1931- 1970; and the Shared Applications Computer System (SACS) database. Fire perimeters of cover types prior to those described in Despain (1972) were combined with other historic perimeter maps that included downfall from post- 1988 fires. Fire perimeters for 2000- 2004 were derived from NBR satellite imagery by comparing areas before and a year after burns to detect change. The number of acres in the park affected by the 1988 fires based on this GIS mapping procedure is approximately 1.1 million acres, rather than the often- cited 793,000 acres burned as evidenced by satellite imagery taken in October 1988 immediately following the 1988 fire season. Appendix K contains a map showing Yellowstone's fire history from 1881- 2004.


Yellowstone National Park
MT, WY, ID
National Park Service
U.S. Department of the Interior
Figure 3. Fire Management Units
North Entrance
Northeast Entrance
Northern Range
Mammoth
Tower
Northwest
Washburn Range
Mirror Plateau
Norris
Canyon Village
West Entrance
Madison
Central Plateau
Fishing Bridge
Lake
Bridge Bay
Old Faithful
East Entrance
West Thumb
Grant Village
Southwest
Southeast
Bechler
South Entrance
Fire Management Units (FMU) boundaries follow major park roads for most of their length. Where the road bounds Yellowstone or Lewis lakes, the FMU boundary was adjusted to follow the shoreline.
Fire Management Units
Major Roads
Developed Areas
Lakes
0 5 10 20 30
Miles
Produced by the Yellowstone Spatial Analysis Center (307)344-2246
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(1) Northern Range

The 149,358- acre Northern Range FMU is located in the north- central portion of the park. The northern boundary of this FMU borders the Gallatin National Forest to the west. The eastern boundary runs north of Cooke City, Montana, and is adjacent to the Beartooth Mountains/Absaroka- Beartooth Wilderness Area in the Gallatin National Forest. The southern boundary follows the highway south and west from the Northeast Entrance of the park along the Soda Butte drainage paralleling the highway to Tower Junction and into Mammoth Hot Springs (Yellowstone headquarters). The western boundary runs north from Mammoth Hot Springs and terminates at the park's North Entrance adjacent to the gateway community of Gardiner, Montana. Elevations range from 5,200 feet near Gardiner to the top of Barronette Peak, an elevation of 10,400 feet, located in the eastern portion of this FMU.

The developed areas located in or adjacent to the Northern Range FMU are Mammoth Hot Springs (Yellowstone National Park Headquarters site), Tower-Roosevelt (Tower Ranger Station, Roosevelt Lodge and associated guest cabins), Lamar Ranger Station, and the Northeast Entrance Station. There are 210 frontcountry structures, 10 backcountry structures, 4 campgrounds (Mammoth, Tower Falls, Slough Creek and Pebble Creek), 39 backcountry campsites and 117 miles of trails.

The Northern Range FMU is unique for Yellowstone because the vegetation is dominated by 56,088 acres of Douglas fir stands covering 38% of the FMU and 46,553 acres of sagebrush/grass meadows (covering 31% of the FMU). This vegetation type supports year- round grazing by the northern range elk herd as well as a permanent herd of bison. Significant groves of aspen (approximately 900 acres) are also located in this FMU, which is an important food source for the resident elk herds. Lodgepole pine stands cover 25,627 acres of this FMU or 17% of the area.

The 1988 fire season had a greater impact on the Northern Range FMU than any of the other six FMUs. During the latter stages of the 1988 fire season, three fires burned 73,781 acres, which accounted for more than 95% of the fire activity that has been recorded to date for this FMU. Not counting these three fires, there have been 213 fires recorded for the years 1881- 2004. Historically, fire behavior in this FMU is characterized by frequent, mixed severity, but relatively small fires that are constrained by high live fuel moistures in the sagebrush/grassland vegetation throughout the growing season. As evidenced in 1988, extreme drought conditions associated with dry cold front passages can produce wind- driven stand-replacement crown fire.

Yellowstone and the Gallatin National Forest have a signed agreement found in the *2000 GYCC Guide* that allows for WFU fires to burn across the common administrative boundary lines. These fires will be managed under a Unified Command strategy according to the *Implementation Guide*.

This FMU has only one fire weather station located at Mammoth. This station has excellent weather records that date back into the 1930s. The Mammoth station is the principal fire weather station for the park and well represents the fuels and fire weather/behavior conditions on the northern range.

The historic Northeast Entrance station is immediately adjacent to the northeast boundary of the park and the Gallatin National Forest to the east. The gateway communities of Silver Gate and Cooke City, Montana, are eight miles to the east of the entrance station. Approximately 900 acres of late- successional lodgepole pine stands are contained in this area. In 2003, the park treated 24 acres of hazardous fuels around the historic entrance station and adjacent housing area under the WUI hazardous fuel reduction program. However, heavy fuel loads remain in this critical boundary area that pose a threat to surrounding communities and valued park structures. The park proposes to reduce these fuel loads through two phases of prescribed fire during the next 5- 10 years. Funding has not been secured and compliance under NEPA, NHPA, or the ESA has not begun. The earliest implementation year for phase I (300 acres) could be 2008. A second phase of approximately 600 acres could be implemented in 2009 or beyond.

(2) Northwest

The 337,747- acre Northwest FMU is located in the northwest corner of the park. The eastern boundary borders the Northern Range and Washburn Range FMUs. The northern boundary borders a small portion of private land northwest of Gardiner as well as the Gallatin National Forest. The western boundary is completely bordered by the Gallatin National Forest with the southern boundary bordering the Southwest and Central Plateau FMUs. Elevations in this FMU range from 5,200 feet near Gardiner to 10,992 at the top of Electric Peak, the second tallest mountain in the park and the dominant peak in the northern portion of the park.

The developed areas located in or adjacent to the Northwest FMU are Mammoth Hot Springs, Norris Junction and Madison Junction. The gateway community of West Yellowstone, Montana, is located west of the West Entrance station. The busy highway corridor of Highway 191 runs from the community of West Yellowstone, Montana, north to Bozeman, Montana. There are 192 front country structures, 8 backcountry structures, two major campgrounds (Indian Creek and Madison), 32 backcountry campsites, and 187 miles of trail.

All fire management options will be conducted in this FMU; however, the agreement for WFU fires to cross the administrative boundary with the Gallatin National Forest does not exist because there are no lands designated as wilderness adjacent to this FMU. This will limit some WFU candidate fires in the extreme northwest and northern portions of this FMU, but all opportunities for WFU will be explored as fire behavior conditions allow.

The Northwest FMU vegetation is extremely varied but is primarily dominated by lodgepole pine which covers approximately 201,000 acres. Whitebark pine covers some 26,000 acres while spruce/fir covers 23,000 acres, and Douglas fir covers 20,000 acres. Approximately 60,000 acres are non- forested and predominantly covered by sagebrush and grass species. Aspen stands are found on approximately 1,700 acres, the most of any of the seven FMUs.

Fire has impacted 70% of this FMU from 1881- 2004, with 205,642 acres burning in 1988. In 1988, stand- replacing crown fires swept across the Cougar and Maple Creek flats and the Fan Creek drainages, pushed by strong winds up the steep slopes in the northwest portion of this FMU. Fire activity is moderate to heavy in this FMU, with 329 fires reported in the period 1931- 2004.

This FMU has one fire weather station located at the Mt. Holmes lookout and one RAWS station on Quadrant Mountain, just north of West Yellowstone above Fan Creek. The Mammoth fire weather station is used to best represent the portion of this FMU east of the mountain range from Mt. Holmes north to Electric Peak. The U.S. Forest Service (USFS) weather station at the Hebgen Ranger Station in West Yellowstone, Montana, is also used to provide an excellent predictor in the relatively flat sections of this FMU north and east of the town of West Yellowstone, and west of the Mt. Holmes lookout.

(3) Washburn Range

The 147,471- acre Washburn Range FMU is located in the central part of the park; the inner- loop road system delineates the unit. The Washburn Range FMU is bordered by the Northern Range FMU on the north, the Mirror Plateau FMU on the east, the Central Plateau FMU on the south, and the Northwest FMU on the west. The FMU derives its name from the Washburn Range Mountains that dominate the eastern portion of this FMU. Mt. Washburn, at an elevation of 10,243 feet, is the highest point in this FMU.

The developed areas located in or adjacent to the Washburn Range FMU are Mammoth Hot Springs, Tower- Roosevelt, Canyon Village, and Norris Junction. There are 348 front country structures, 2 backcountry structures, three major campgrounds (Tower Falls, Canyon Village, and Norris), 14 backcountry campsites, and 53 miles of trail.

The vegetation is predominantly lodgepole pine stands, which cover 104,968 acres. Douglas- fir covers 10,183 acres, whitebark pine covers 8,707 acres, spruce/fir stands cover 1,236 acres, and aspen covers 682 acres. There are 21,304 acres of non- forested lands predominantly covered by sagebrush and grass species.

Fire has burned approximately 122,022 acres from 1881- 2004, with the majority of these acres (106,233) burning in 1988 as a result of the human- caused North Fork fire. Due to the mountainous terrain that characterizes this FMU, the wind- driven

fire storms in 1988 burned extremely hot, and the majority of the acres burned were stand- replacement.

This FMU has three manual fire weather stations located at Mammoth Hot Springs, Canyon Village and the Mt. Washburn Lookout station. The Mammoth station is the driest location in the park, the high elevation Mt. Washburn lookout station is characterized by consistently strong winds, and the Canyon station is the wettest fire weather station, with rainfall being deposited on the windward and lee side of Mt. Washburn.

(4) Mirror Plateau

The 428,589- acre Mirror Plateau FMU is located in the northeastern and central-eastern portion of the park. This FMU borders the Northern Range FMU along its northern boundary and the communities of Silver Gate and Cooke City, Montana, at its northeastern tip. This FMU shares its long eastern boundary with the Shoshone National Forest, the Southeast FMU including a portion of Yellowstone Lake along its southern boundary, the Central Plateau FMU along its southwestern boundary, and the Washburn Range FMU along its northwestern boundary.

The developed areas located in or adjacent to the Mirror Plateau FMU include the Northeast Entrance station, East Entrance station, Fishing Bridge Junction near the Lake Developed Area, Canyon Village, Tower Junction, and the Lamar Buffalo Ranch and Ranger Station. There are 195 front country structures, 17 backcountry structures, 2 campgrounds (Fishing Bridge and Canyon Village), 45 backcountry campsites, and 219 miles of trail in this FMU.

The Mirror Plateau is a very remote FMU with few permanent structures away from the road system and an extensive boundary along its eastern portion with adjacent wilderness lands on the Shoshone National Forest. This FMU easily meets all the parameters for WFU fires with liberal Maximum Manageable Areas (MMAs) to be developed to encourage natural fire processes. (See Section IV, B, 3, on page 45 for a discussion of MMAs).

The Mirror Plateau FMU is dominated by lodgepole pine stands that cover 229, 583 acres. It has the second largest amount of whitebark pine stands of any FMU, totaling 90,284 acres. There are also 33,015 acres of Douglas- fir stands; 6,232 acres of spruce- fir, 419 acres of aspen, and 66,370 acres that are classified as non-forested, dominated by sagebrush and grass species.

The Mirror Plateau FMU has recorded more fire starts (471) than any other FMU since 1881. Fire has impacted over 60% of the FMU with the majority of the burned acres occurring in 1988, when multiple fires (mainly the Clover- Mist Complex) burned a total of 246,418 acres. A total of 255,683 acres have burned in the period 1881- 2004 (including 1988), predominantly in the lodgepole pine forests. Anecdotal observations have noted that the Mirror Plateau is in the main lightning storm track across the park that travels from the southwestern portion of the park across Yellowstone Lake and to the northeast across this FMU.

Yellowstone and the Shoshone National Forest have a signed agreement found in the *2000 GYCC Guide* that allows for WFU fires to burn across the common administrative boundary line. Any fire that has the potential to burn across this administrative boundary will be managed under a Unified Command strategy according to the *Implementation Guide*.

This FMU has three fire weather stations: Mt. Washburn Lookout, Canyon Village, and the East Entrance. The Canyon station is the wettest of the fire weather stations and provides the lowest fire danger indices on an average basis; the Mt. Washburn station located at over 10,000 feet elevation is a windy station and provides high-wind fire danger information; and the East Entrance is a lower and drier station that provides the highest fire danger indices. A daily analysis of these three stations provides a good cross- section of the fire danger indices across this large FMU.

(5) Central Plateau

The 226,169- acre Central Plateau FMU is located in the central to central- western portion of the park. This FMU borders the Washburn Range FMU to its north, the Mirror Plateau FMU to its northeast, Yellowstone Lake in the Southeast FMU along its southeastern border, the Southwest FMU along its southern and southwestern border, and the Northwest FMU along its northwestern border. The southeast portion of the FMU is at the western edge of the lightning- storm track through the park, and for its size, records an above average number of lightning starts each year. This FMU is delineated entirely by the inner- loop park road system, but is still remote in nature as it has only a few miles of trail that traverse across the center of the plateau.

The developed areas located in or adjacent to the Central Plateau FMU are Norris Junction, Canyon Village, Fishing Bridge, Lake, West Thumb, Old Faithful, and Madison Junction. This FMU contains the world renown historic district of Old Faithful that houses the Old Faithful Inn and Geyser Basin as well as the vast Lake Developed Area housing the historic Lake Hotel built in 1891. There are 430 front country structures (the most of any park FMU), 3 backcountry structures, the Bridge Bay, Norris Junction, Canyon Village, Fishing Bridge, Grant Village, and Madison Junction campgrounds, 3 backcountry campsites, and 54 miles of trail.

The Central Plateau FMU is home to most of the thermal features in the park, in particular the geyser basins surrounding the Old Faithful developed area, as well as the Upper, Midway and Lower Geyser Basins. The vast nonforested Hayden Valley is located in the northeastern section of this FMU and provides a barrier for fire spread due to the high live fuel moistures throughout the growing season. This FMU meets all the parameters or WFU fires; however, protection of the Lake and Old Faithful developed areas and the 433 structures located in this FMU and along its borders is a high priority.

The Central Plateau is dominated by lodgepole pine that covers 90% of the FMU. The sagebrush and grasslands of the Hayden Valley and other non- forested lands cover 22,317 acres, spruce- fir stands cover some 416 acres, and whitebark pine stands cover only 27 acres. There are no significant stands that are classified as either Douglas- fir or aspen.

The Central Plateau FMU has been the least impacted by fire of any of the FMUs. Approximately 54,285 acres burned in 1988 and a total of 60,137 acres burned from 1881- 2004. The Lake developed area including the maintenance area is located in an old- growth forest that did not burn during the 1988 fires. Although 67 forested acres in the Lake Utility Area were treated in 2003 in under the WUI hazardous fuel reduction program, additional hazardous fuel treatments may be needed in the future to protect existing structures.

This FMU has two fire weather stations: one long- term station at Old Faithful located in the southwest area of the FMU and the station at Canyon Village in the northeast corner of the FMU. The Old Faithful station best represents the fire danger in this FMU because it is in a dry location, which characterizes the dry geyser basins and Hayden Valley.

(6) Southwest

The 438,510- acre Southwest FMU is located in the southwest portion of the park. This FMU is the second- largest FMU by total area but has the most land mass and thus the highest number of burnable acres. This FMU is bordered by the Northwest and Central Plateau FMUs to the north, the Southeast FMU along its eastern boundary, the John D. Rockefeller, Jr. Memorial Parkway and Caribou- Targhee National Forest along its southern boundary, and the Caribou- Targhee and Gallatin National Forests along the long, straight western boundary. This FMU has lands in the three states of Wyoming, Idaho and Montana.

The developed areas located in or adjacent to the Southwest FMU include West Entrance station, Madison Junction, Old Faithful, West Thumb, Grant Village, Belcher Ranger Station and the South Entrance station. The gateway community of West Yellowstone, Montana, is to the west of the West Entrance station. There are 187 front country structures, 12 backcountry structures, 2 campgrounds (Madison Junction and Grant Village), 69 backcountry campsites, and 218 miles of trail.

Yellowstone, the Caribou- Targhee and Gallatin National Forests, and the John D. Rockefeller, Jr. Memorial Parkway have a signed agreement found in the *2000 GYCC Guide* that allows for WFU fires to burn across common administrative boundaries, provided all criteria for WFU are met by all units involved. The area for potential WFU fire activity is mainly along the southern boundary portion of this FMU, as those are the only lands that are designated wilderness and are administered by the Caribou- Targhee National Forest, as well as the John D. Rockefeller, Jr. Memorial Parkway which is administered by Grand Teton National Park.

The Southwest FMU is a vast plateau dominated by the sparsely forested Pitchstone Plateau and the densely forested Belcher Canyon. This FMU contains the most acres of lodgepole pine of any FMU with 351,725 acres accounting for 80% of the forest species types in the FMU. Spruce- fir stands dominate 28,453 acres, while non- forested (mainly sagebrush and grasslands) dominate 26,230 acres. Whitebark pine stands are found on 16,585 acres, while Douglas- fir stands cover 4,833 acres. Aspen stands cover only 55 acres. The two major lakes in this FMU–Shoshone Lake and Lewis Lake–cover 10,342 acres.

Approximately half of this FMU unit burned during 1881- 2004; 458 fires burned 196,145 acres. Most of these acres burned during 1988 (178,396 acres) in the North Fork and Snake River Complexes as a result of the North Fork fire. There are no major mountain ranges in this FMU; wind- driven fires burn in a southwest to northeast direction. The North Fork fire was human- caused and began on the Caribou- Targhee National Forest to the southwest of this FMU.

This FMU utilizes three fire weather stations. The Bechler Ranger Station had a manual fire weather station that was replaced by a Remote Automatic Weather Station (RAWS) in 2000. Since this weather station is located in the extreme southwest corner of this FMU and fires spread from the southwest to the northeast, this station best characterizes the fire danger in this FMU. The weather stations at Old Faithful and the Mt. Sheridan lookout are also used as good fire danger cross references for this FMU.

(7) Southeast

The 469,885- acre Southeast FMU is located in the southeastern portion of the park. This is the largest FMU by total area but not by number of burnable acres. Yellowstone Lake and Heart Lake comprise 87,445 acres. This FMU is bordered by the Mirror Plateau to the north, the Shoshone and Bridger- Teton national forests along its eastern boundary, the Bridger- Teton National Forest and the John D. Rockefeller, Jr. Memorial Parkway along its straight southern boundary, the Southwest FMU on its western boundary, and the Central Plateau FMU on its northwestern boundary. The southeastern corner of this FMU is also the most remote area in the lower 48 contiguous states by being the farthest location from a highway.

The developed areas located in or adjacent to the Southeast FMU are Lake, Fishing Bridge, the East Entrance station, the Thorofare Ranger Station, the South Entrance station, Grant Village, and West Thumb. There are 132 frontcountry structures, 21 backcountry structures, 3 campgrounds (Bridge Bay, Fishing Bridge and Grant Village), 91 backcountry campsites, and 183 miles of trail.

The Southeast FMU is dominated by Yellowstone Lake, as well as by unburned stands of old growth forests along the eastern boundary with the Shoshone National Forest. This FMU is dominated by two species: lodgepole pine stands that cover 199,480 acres (42% of the FMU) and the largest stands of whitebark pine of any FMU at 102,039 acres or 22% of the FMU. Water covers 87,445 acres, non- forested sagebrush and grasslands cover 38,931 acres, spruce- fir stands are found on 7,254 acres, and Douglas- fir stands cover only 1,019 acres, while aspen is found on 78 acres.

Fire has impacted most of this FMU, having burned 322,472 acres from 1881- 2004. Of these acres, 241,416 acres burned during the 1988 fire season. Due to the remoteness of this FMU, the fire suppression forces assigned to park fires in 1988 were concentrated in the more heavily developed FMUs, protecting structures with relatively little action taken in the Southeast FMU. The Snake River Complex of fires along with the Huck and Mink fires that started outside the park and burned into the park, accounted for the majority of acres burned in 1988. Fire behavior in this FMU is also characterized by wind- driven fire activity with fires burning from the southwest to the northeast.

Yellowstone, the Shoshone and Bridger- Teton National Forests, and the John D. Rockefeller, Jr. Memorial Parkway have a signed agreement found in the *2000 GYCC Guide* that allows for WFU fires to burn across common administrative boundaries, provided all criteria for WFU are met by all units involved. The USFS lands that border the southern and eastern portions of this FMU are all designated wilderness areas and vast acreages have been impacted by fire since 1988; WFU is the AMR action best suited for this FMU.

This FMU utilizes three fire weather stations: the Thorofare RAWS established in 1991, the Mt. Sheridan lookout station at 10,308 feet, and the East Entrance station. The lower valleys of this FMU are well represented by the Thorofare RAWS and East Entrance station which often record the warmest temperatures in the park on a daily basis. The Mt. Sheridan lookout is a long running fire weather station, and data has been correlated with parkwide lightning- caused fire starts as well as stand-replacing crown fire activity.

b. Description of Cultural Resources

Because the majority of cultural resources have not been identified for the park, these resources are described in the following section on a parkwide basis, rather than for each FMU. As individual sites are identified in the future for protection

during fire management activities, they will be mapped for each FMU. Annual surveys and discussions with park cultural resource and fire management specialists both prior to the fire season and during the fire season provide the basis for protection of cultural resources under Yellowstone's fire management program.

(1) Museum Collections

The NHPA, NPS Management Policies 2001, and Director's Order #28*:* Cultural Resource Management Guidelines (DO- 28, USDI 1998*b*) require the consideration of impacts on museum collections (archeology, ethnology, history, biology, paleontology, geology, and archives) from the park's fire management program.

The majority of the park's 5.3 million museum objects are housed in the recently constructed Yellowstone Heritage and Research Center located at the park's North Entrance station in Gardiner, Montana, which meets the standards of the American Association of Museums. Protection of museum objects that are housed in park buildings falls under the park's structural fire management program and not the wildland fire management program. Any museum objects not housed in facilities will be afforded the same level of protection as other cultural resource features under the wildland fire management program.

(2) Archeology

Humans have occupied the GYA for more than 11,000 years. Currently archeological evidence indicates that the majority or all of the use of the park occurred during non- winter months, and was less during the recent Little Ice Age (A.D. 1400- 1860) than in the previous millennia. A number of archeological sites provide evidence of Native American presence in the park. These sites include hearths, roasting pits, game drives, hunting blinds, base camps, chipping stations, rock shelters, wickiups, quarries and tipi rings. The Crow, Shoshone, Bannock, Nez Perce, Blackfeet, and Gros Ventres were the primary historic tribes to have visited the park. However, very little of the park's prehistoric archeological resources can be ethnically identified. The Sheepeaters are a group of Shoshone that are said to have occupied portions of Yellowstone during the first half of the nineteenth century; however, methods of identifying their sites from those of other tribes are not known.

More than 1,252 prehistoric and historic sites have been documented in Yellowstone, although less than five percent of Yellowstone's 2.2 million acres have been intensively inventoried for archeological resources. Included within the historic archeological sites are those of Euro- American origin such as solider stations, hotels, and can dumps. Approximately one- third of the archeological sites have been evaluated for eligibility to the National Register of Historic Places. Obsidian Cliff, a prehistoric obsidian quarry, has been named a National Historic Landmark. Approximately 100 sites are added each year to the NPS Archeological

Sites Management Information System database, and Determinations of Eligibility are completed when needed or when time permits.

(3) Ethnography

The NPS DO- 28 defines ethnographic resources as "the cultural and natural features of a park that are of traditional significance to traditionally associated peoples." Traditionally associated peoples are those that have an association with a park landscape before it became a national park. There are at least 26 associated American Indian tribes, each having particular historical traditions associated with what is now Yellowstone. Consequently, places and resources inside the park continue to hold both historical and contemporary traditional significance.

Tribes associated with Yellowstone, and with whom consultation occurs on a semi-annual basis, are: 1) Assiniboine & Sioux Tribes; 2) Blackfeet Tribe; 3) Cheyenne River Sioux Tribe; 4) Coeur d'Alene Tribe; 5) Comanche Tribe of Oklahoma; 6) Confederated Tribes of the Colville Reservation; 7) Confederated Tribes of the Umatilla Reservation; 8) Confederated Salish & Kootenai Tribes; 9) Crow Tribe; 10) Crow Creek Sioux Tribe; 11) Eastern Shoshone Tribe; 12) Flandreau Santee Sioux Tribe; 13) Gros Ventre and Assiniboine Tribes; 14) Kiowa Tribe of Oklahoma; 15) Lower Brule Sioux Tribe; 16) Nez Perce Tribe; 17) Northern Arapaho Tribe; 18) Northern Cheyenne Tribe; 19) Oglala Sioux Tribe; 20) Rosebud Sioux Tribe; 21) Shoshone- Bannock Tribes; 22) Sisseton- Wahpeton Sioux Tribes; 23) Spirit Lake Sioux Tribe; 24) Standing Rock Sioux Tribe; 25) Turtle Mountain Band of the Chippewa Indians; and 26) Yankton Sioux Tribe. An additional 84 American Indian tribes are consulted about the management of Yellowstone's bison herds.

To date, 158 ethnographic resources have been recorded for Yellowstone. They include specific places of historical importance, hydrothermal features, plants, and wildlife. An ethnographic overview and assessment published in 2002 summarizes resources and traditions associated with 10 affiliated tribes (Nabokov and Loendorf 2002). Yellowstone continues to collect data on ethnographic resources through consultations and oral history interviews with the 26 currently associated tribes. Information on these resources is entered into the NPS Ethnographic Resources Inventory database, which currently includes more than 220 resources.

(4) Historic Properties

Yellowstone has 1,030 historic structures entered on the List of Classified Structures (LCS) as of September 30, 2004. Of these structures, 375 are listed on the National Register of Historic Places and 351 have been determined eligible for listing. The remaining 304 structures and buildings still need to be evaluated for eligibility to the National Register. National Historic Landmarks include the Fort Yellowstone National Historic Landmark District which has forty seven buildings, structures and historic landscape features, and five individual NHL structures, including the Northeast Entrance station, the Norris, Madison, the Fishing Bridge Trailside

Museums, and the Old Faithful Inn. The majority of Yellowstone's historic structures are located within six historic districts and other developed areas. Historic Districts that have had Consensus Determinations of Eligibility are the Canyon Village Historic District (Mission 66), the Blister Rust Camp at Canyon Administrative Area, the Old Faithful Visitor Center Historic District (Mission 66), Tower Junction Historic District, Stephens Creek Administrative Area in Montana, and the Fishing Bridge Historic District.

Some of the structures and buildings are located outside of the historic districts or are discontiguous contributing properties to existing historic districts and developed areas. Examples of these include backcountry patrol cabins, fire towers, interpretative kiosks, snotels, seismic stations, stream flow gauging stations, roadside features, bridges, stone guardwalls and retaining walls, and other structural elements.

(5) Cultural Landscapes

According to NPS DO- 28, a cultural landscape is:

"…a reflection of human adaptation and use of natural resources [often] expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions."

Through a Level II Cultural Landscape Inventory (CLI) the park has initiated Consensus Determinations of Eligibility with the Montana SHPO for the Cultural Landscape at the Stephens Creek Administrative Area and with the WYSHPO for the Cultural Landscape at Artist Point Overlook. The park has submitted to WYSHPO and MTSHPO Level I CLIs for the Canyon Village, South Entrance station, and West Entrance station developed areas. Further study through a Level II CLI will be necessary for determination of eligibility. The park is currently developing a Level II CLI for the Old Faithful developed area. Other potentially eligible cultural landscapes were identified in 2000 for Yellowstone, but have yet to be evaluated or determined eligible.

c. Description of Natural Resources Parkwide

Natural resources are described on a parkwide basis, rather than for individual FMUs. Sensitive areas, habitat, and species, will be identified by individual FMUs annually based on surveys, research, and recommendations with park natural resource specialists both prior to the fire season during pre- season planning and wildland fire management responses during the fire season.

(1) Vegetation

Yellowstone contains diverse vegetation as a result of topographic relief, differing soils, varied slope and aspect, and range of microclimates. The park includes seven vegetation zones, ranging from desert to alpine tundra. Approximately 1,200 to 1,300 plant species have been identified in the park, but most of the landscape is dominated by a few vegetative community types (Whipple 2001). Lower elevations, between 5,000 and 7,000 feet, support grasslands, shrublands, and wet meadows. Species found in grasslands include bluebunch wheatgrass (*Agropyron spicatum*), Hood's phlox (*Phlox hoodii*), and rosy pussytoes (*Antennaria rosea*). Shrublands generally consist of sagebrush (*Artemisia* spp.), rabbitbrush (*Chrysothamnus* spp.), yarrow (*Achillea* spp.), wild buckwheat (*Eriogonum* spp.), Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass, and junegrass (*Koeleria macrantha*). In wet meadows, willow (*Salix* spp.), cinquefoil (*Potentilla* spp.), American bistort (*Polygonum bistortoides*), tufted hairgrass (*Deschampsia caespitosa*), alpine timothy (*Phleum alpinum*) and a variety of sedges (*Carex* spp.) can be found.

Approximately 80 percent of the park is forested, with the majority dominated by lodgepole pine (*Pinus contorta*). This community is found in a variety of successional stages at elevations between 7,500 and 9,000 feet. Lodgepole communities cover about 1.4 million acres of parkland. In moist areas and on rich soils, Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) are the predominant climax forests. At elevations ranging from 6,000 to 7,600 feet, Douglas- fir (*Pseudotsuga menziesii*) and aspen (*Populus tremuloides*) stands are common. Whitebark pine (*Pinus albicaulis*) is found as the dominant overstory species above 8,400 feet, with alpine tundra above treeline at 9,400 feet.

About 160 of the plant species found in Yellowstone are listed as species of special concern in the state of Wyoming. Two of the notable rare endemic species include Yellowstone sand verbena (*Abronia ammophila*), a member of a primarily tropical plant family (Nyctaginaceae, the four o'clock family) with very few species growing as far north as Yellowstone, and Ross' bentgrass (*Agrostis rossiae*), a species with an affinity for thermal areas that can be found growing in soils whose temperature one inch below the surface is 100° Fahrenheit. The plant species of concern that grow in Yellowstone may be found on the Wyoming Natural Diversity Database internet site (http://uwadmnweb.uwyo.edu/WYNDD/).

The number of documented exotic plants in the park has increased over the years to 187 species, representing about 15 percent of the vascular plant species in the park (Whipple 2001). Thirty of these plants are classified as noxious in Idaho, Wyoming and Montana. The park has a comprehensive weed management program to control their presence (Olliff et al. 2001).

Fire has been an important factor in Yellowstone's environment whenever vegetation has covered the ground. Fire is one of the major environmental factors influencing the relationships between the various forms of life and their

environment. The plants and animals that inhabit the park have adapted to the effects of fire. The ability to sustain life is improved by fire in many habitats. In nearly all forms of life, the number of species is highest in post- burn forest communities just before the tree crowns grow together and completely shade the forest floor. Fires that burned before Yellowstone was established created a mosaic of forests in various stages of regrowth. This mosaic is an important part of the Yellowstone landscape and is vital to the preservation of the natural qualities of the park.

Plant species are adapted to fire in many ways. The serotinous cones of lodgepole pine are an example of a specific adaptation to fire. The windblown seeds of Engelmann spruce and subalpine fir as well as the habit of the Clark's nutcracker, which caches whitebark pine seeds, are also mechanisms that reintroduce plants to a burned area. Research following the 1988 fires (Clark 1990) has shown that a great number of seeds from numerous plant species survived the fires in the soil. Other studies (Despain 1990) have found that within a year, these seeds, along with rhizomes, bulbs, root crowns, and other reproductive structures, provide a highly variable plant cover on the burned sites. Furthermore, Turner et al. (1997) discuss the contribution of pioneering plant species to continued recolonization of recently burned areas.

Mineral nutrients are vitally important to plants, and an initial increase in plant nutrients following a fire may last up to four years. A corresponding increase in plant productivity may last for a longer period, depending upon the species (Christensen 1988). Following a fire, there is also an abundant supply of soluble minerals which are absorbed and increase plant growth (Despain 1973).

The effects of fire on vegetation are highly dependent upon the environmental conditions and the plant community that existed on the site before fire. In grassland fuel types, fire stimulates flowering in many species, such as lupine, and production of vigorous new leaves in many grasses. Small areas beneath sagebrush plants can burn sufficiently to kill all plants and seeds, providing seedbeds for neighboring plants. Open areas occur in forested communities where deep accumulations of organic matter burn during a fire. These sites are places for seedling establishment. In sites where soil nutrients are favorable and water is readily available, the plant community is abundant and diverse. When these communities burn, revegetation occurs quickly. In sites where growing conditions are poor and the plant community is sparse, the post- burn vegetation is scattered and slow in covering the ground.

Fire intensity may also affect the vegetative response to fire. Where soil and duff moisture content is high, there is little effect on the vegetation other than killing the above- ground trees or shrubs. When soil and duff moisture content is low, the above- ground plants as well as seeds and rhizomes in the upper soil layer can be killed. The vegetation must then regrow from seeds and plant parts found deeper in the soil. Fire intensity can therefore add to the overall mosaic pattern of the park's plant communities.

(2) Soils

Four soil types have been identified in Yellowstone. The two predominate soil types in the park are derived from two major parent materials: rhyolite and andesite. A third type, loess, evolved from glacial episodes and is found in the floodplains of area rivers. A fourth soil type makes up about 6 percent of the park and is derived from sedimentary rocks consisting of limestones, sandstones, and shales. Andesitic soils have better moisture- holding capacity and higher levels of nutrients compared to rhyolitic soils. Climax lodgepole pine is generally associated with rhyolitic soils, while climax spruce and fir are typically associated with andesitic soils.

Extensive postfire studies (including studies from the 1988 fires), mapping of burn intensity, and soil sampling at hundreds of locations over the Yellowstone Plateau have shown that most fires in the park heat the soil to only light or moderate intensity. Less than one- tenth of 1 percent of soils in the area were heated to an intensity that penetrated more than two inches deep and consequently kill seeds, roots, bulbs, rhizomes, and other plant tissues necessary for regeneration. In certain areas, steep topography and canyon "chimneys" can cause the percentage of high intensity or severe burn to be as high as 10 to 15 percent. Generally, severe heating only occurs beneath large fallen logs, in deep duff, and where dead and dry roots are consumed by fire. Soils that are burned at this intensity have all of the organic matter volatilized, and an external seed source is required to revegetate plants species. Soil heating can also cause short- term changes in water infiltration potential and an increase in water repellency, which may result in increased runoff and possible erosion events if rapid snowmelt or intense summer thunderstorms occur (Christensen 1988).

Nutrient availability from ash may increase soil fertility for a few years immediately following a fire. This may be favorable for many species of plants, nitrogen- fixing microbes, and nitrifying bacteria. Soil and microclimatic conditions following a fire also favor establishment and growth of native herbaceous and shrub species that may be important in replenishing nitrogen lost during burning (Christensen 1988, Christensen et al. 1989).

Soils in burned areas tend to warm up sooner in the spring and reach higher temperatures than soils covered by vegetation. For some years following a fire, these warmer temperatures increase soil microbial activity and extend the growing season. In the Yellowstone ecosystem, these factors, plus the increased availability of nutrients, are directly responsible for increased plant production following fires (Christensen 1988).

(3) Air Quality

The Clean Air Act (42 USC 7401 *et seq*.) recognizes the need to protect visibility and air quality in national parks. By definition, national parks, including Yellowstone, are mandatory Class I areas and are therefore given the highest level of air quality

protection. In Class I airsheds, air quality is better than the National Ambient Air Quality Standards, and there is little allowance for deterioration of air quality. Monitoring stations are set up in different areas of the park to evaluate air quality conditions and compare them with federal and state standards. The Montana Department of Environmental Quality Monitoring and Data Management Bureau installed and regularly examine a carbon monoxide monitoring station on the northeast side of the west entrance of the park and a particulate sampling station outside of the park in the town of West Yellowstone and at Old Faithful. Dry atmospheric deposition and wet (acid rain) deposition are monitored at Tower Falls in the Northern Range FMU through the park's participation with the National Atmospheric Deposition Program. Yellowstone also participates with the Environmental Protection Agency (EPA) in operating a site that provides atmospheric data and ground- level ozone through the program CASTNet, Clean Air Status and Trends Network. Lastly, the park participates in a collaborative visibility monitoring program known as the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. The equipment for both the IMPROVE and CASTNet programs are located at Yellowstone Lake, which measure atmospheric concentrations of aerosols, sulfates, nitrates, ammonium, sulfur dioxide, nitric acid, and ozone levels.

Results from the several monitoring stations throughout the park indicate that all park areas meet federal and state ambient air quality standards. Because there is little industrial activity and a relatively low human population in northwestern Wyoming, the overall regional air quality of the park is good. The major sources of air pollutants in the park are those emitted by vehicle emissions and smoke from fires.

Smoke and the chemicals produced by forest fires have a variety of effects upon air quality. The primary products of combustion of organic materials include carbon dioxide, water vapor, carbon monoxide, particulate matter, hydrocarbons, nitrogen oxides, and trace minerals. In addition to the compounds considered pollutants in smoke, forest fire smoke also contains and distributes elements, compounds, and minerals considered to be biological building blocks necessary for the creation and production of plant tissues. Nutrients that were previously stored in vegetative or woody matter, such as carbon, phosphorus, nitrogen, calcium, and potassium, while mostly released as ash, are also carried in smoke and fall to the earth's surface over a broad geographic area. Although not widely studied, it is hypothesized that these nutrients may stimulate plant production in areas receiving the fallout from forest fires. Smoke is also known to have anti- fungal properties, but the effect of this phenomenon on adjacent unburned plant communities has not been adequately researched.

The Clean Air Act provides that federal land managers have an affirmative responsibility to protect air quality related values including visibility, plants, animals, soils, water quality, cultural resources, and visitor health from adverse pollution impacts. During a wildfire event, high concentrations of carbon monoxide, other gases, and particulate matter can be released affecting air quality. Air quality

standards for allowable emissions are based on health effects to humans. These standards are intended to protect sensitive members of the population with adequate safety margins. Effects to humans from smoke is usually limited to firefighters suppressing forest fires or fire management personnel conducting prescribed fires.

In addition to health effects, wildfire smoke could affect visibility in the park. Fire management activities in Yellowstone which result in the discharge of air pollutants are subject to, and must comply with, all applicable federal, state, interstate, and local air pollution control requirements. Smoke mitigation measures are employed by the park to minimize impacts to visibility and air quality within the park and surrounding areas.

(4) Wilderness

The establishment of the 1964 Wilderness Act (16 USC 1131 *et seq*.) provided for protection of wilderness areas for future generations. With completion of the *Final Environmental Statement: Proposed Wilderness Classification, Yellowstone National Park, Wyoming* (USDI 1973) NPS recommended that 2,016,181 acres in 10 roadless units in Yellowstone be designated as wilderness by an act of Congress. A final determination of the wilderness proposal has yet to be completed by Congress. The majority of each of the seven delineated FMUs are recommended wilderness areas.

Management of natural resources in proposed wilderness focuses on protection and restoration of resources and natural processes. The role of fire as a natural process in wilderness has been well documented. The 1963 Leopold Report in particular pointed to the need to allow natural fire in areas managed as natural parks and wilderness. This landmark document provided impetus for the transition of wilderness management away from object preservation to the inclusion of the natural processes that create and influence ecosystem structure.

NPS Director's Order # 41 (DO- 41), *Wilderness Preservation and Management* and accompanying Reference Manual # 41 (RM- 41) (USDI 1999*b*), and NPS 2001 Management Policies (Section 6.3.9) state that "fire management activities conducted in wilderness areas will conform to the basic purposes of wilderness…" Impacts associated with wildland fire suppression, WFU monitoring, prescribed fire, and non- fire fuels management conducted within wilderness will be consistent with the *minimum requirement concept*, and will be conducted in such a way as to protect natural and cultural resources and to minimize the lasting impacts of fire suppression actions." The minimum requirement concept includes two components: (1) whether the proposed action is appropriate or necessary in wilderness and does not result in a potential significant impact to wilderness resources and character; and (2) the techniques and types of equipment needed to ensure that impacts to wilderness resources and character are minimized. Yellowstone will apply the minimum requirement concept when making decisions concerning wildland fire management in the park's wilderness areas.

DO- 41 and RM- 41 identify the following goals for a fire management program in wilderness areas, including categories of designated, recommended, potential, proposed and study areas:

- Integrate wilderness values and resource considerations in the systematic planning and decision- making processes, determining the most appropriate management strategies for all prescribed fire and for any wildland fires that no longer meet resource management objectives.
- Any Delegation of Authority to an Incident Management Team (IMT) will include appropriate emphasis on the protection of wilderness resources and values.
- Fire suppression teams should be trained in the concepts of wilderness management, preservation of wilderness values, and wilderness fire management. This requirement should be identified in appropriate delegation orders.
- All wildland fires within wilderness areas will be managed to include the minimum requirement suppression techniques, consideration of firefighter and public safety, a cost/benefit analysis, and sensitive natural and cultural resources.
- Wilderness managers will assist in the selection and implementation of appropriate responses to wildland fires in wilderness.
- Resource advisors must be knowledgeable about wilderness values, objectives, and policies.
- Prescribed fire plans in wilderness will include the necessary prescriptions and procedures to protect wilderness resources and values.

(5) Wildlife

Yellowstone is home to one of the largest concentrations of mammals in the lower 48 states. Sixty species of mammals occur in the park, including two species of bear, seven native ungulates and one introduced ungulate species. There are over 300 species of birds, 13 native species of fish, 5 introduced sport fishes, 6 species of reptiles, and 4 amphibian species.

The northern Yellowstone elk herd is one of the largest free- ranging herds in North America. During the past two decades, the number of bison present in Yellowstone has been increasing steadily. The 2003- 2004 early winter count of bison was 4,200. Black and grizzly bears are both dispersed throughout the park and are most likely found in forested areas. Their primary diet includes grasses and sedges, but they opportunistically feed on fish, insects, roots, and berries, and they will scavenge, if necessary.

Four species that inhabit the park are listed as federally threatened under the ESA: Canada lynx, grizzly bear, gray wolf, and bald eagle. Section X, C, discusses the measures that Yellowstone will follow to protect these species, in accordance with the Section 7 consultation conducted with the FWS in February 2005 for the 2004 Update.

(6) Geothermal Resources

Yellowstone contains the world's largest and most active geothermal areas, a principal reason for the establishment of the park. The park has more than 300 geysers and over 10,000 thermal features which includes hot springs, mud pots, and fumaroles. An underground reservoir of water, heated by molten magma, fuels the GYA's thermal features including those in the park. Thermal areas sustain unique and diverse life and support various microbial organisms, mosses and grasses. These resources in turn support a range of other animals from insects to large ungulates such as bison and elk. Plant life in thermal areas often forms characteristic circular patterns with no vegetation in the hot center. Concentric patterns of vegetation reflect the upper temperature limits of different plants. Typically, mosses grow centrally and moving outward from the center grasses and then finally trees are the dominant lifeform.

Thermal features may appear powerful; however, they are fragile systems. Geysers can be altered or destroyed if components of their structure, such as heat, water supply, plumbing system or seal that holds back the pressure in the case of geysers, are altered. Nature itself can destroy geysers. Changes in a thermal feature's water or heat source may cause a feature to die off. Thermal features may change or be destroyed as a result of their seals being breeched during an eruption, seismic activity, or natural processes such as landslides.

(7) Wetlands and Aquatic Resources

Yellowstone encompasses a 3,500 square- mile watershed that provides the surrounding area with high quality water. Streams and lakes in Yellowstone are designated as Class I, Outstanding Resource Waters, by the state of Wyoming. Existing water quality must be maintained in Class I waters. The water resources within Yellowstone cover 112,000 acres. More than 150 lakes compose an area of approximately 108,000 acres. Yellowstone Lake, the largest body of water above 7,500 feet elevation in North America, occupies 139 square miles. Other major lakes include Shoshone, Lewis, and Heart Lakes. More than 220 named and hundreds of unnamed streams form over 2,650 miles of flowing water in the park. River systems in the park include the Gardner, Lamar, Yellowstone, Madison, Firehole, Gibbon, and Lewis Rivers. The hydrology of streams and rivers in the park is driven by snowmelt with peak discharge occurring in the spring. Discharge then declines gradually over summer and returns to near base flow by late fall.

Wetlands comprise 228,766 acres, or approximately 10.3 percent of the park. The predominate wetlands, totaling over 118,500 acres (about 5 percent of the park), are classified as palustrine and include wet meadows, swamps, marshes, potholes, fens, bogs, and shallow ponds. Yellowstone's lacustrine wetlands, defined as lakes and ponds greater than 20 acres in size or having a water depth exceeding 6.6 feet at low water, occupy 100,888 acres or 4.5 percent of the park. Yellowstone Lake, which represents 90 percent of this acreage, is at least 400 feet deep and over 139 square

miles in surface area. Riverine wetlands occupy 9,350 acres of the park (Elliot and Hektner 2000).

Large fires have the potential to increase the total water yield from a drainage and cause the peak runoff to occur earlier in the spring. Removal of vegetation by fire can enhance the possibility that erosion would increase for one to five years following a fire. Rapid snowmelt and summer thunderstorm events may intensify these natural erosion processes. Increased sedimentation may occur in the short- term (one to five years) and may alter the prefire aquatic conditions enough to change the ecological and successional state in ponds, lakes, and streams (Christensen et al. 1989, Minshall 1989).

Reduced shading that results from fire can increase stream and lake temperatures for many years. In a subalpine environment such as Yellowstone, this can increase the pace of physiological and ecological processes and lengthen the growing season. Nutrient availability increases for an indeterminate period of years and can increase aquatic plant response, which may translate into an increased invertebrate and vertebrate response (Albini 1978, Christensen et al. 1989, Minshall 1989). Although the immediate effects of fire can be disruptive to streams and lakes, intermediate and long- term fire effects on streams and lakes will be minimal and of short duration (Christensen et al. 1989, Varley 1989).

2. Strategic and Measurable Fire Management Objectives for Fire Management Units

The fire management objectives for the seven FMUs are:

- Promptly and safely respond to all wildland fires by implementing the AMR that is consistent with agency and departmental policy;
- Provide for the safety of firefighters, visitors, employees and park neighbors during all wildland fire management operations by ensuring that safety is the priority on all fire management actions;
- Ensure wildland fire suppression operations will employ Minimum Impact Suppression Tactics on all suppression fires;
- Ensure that all WFU fires managed for resource benefits follow the guidelines outlined in the *Implementation Guide*;
- Ensure that all prescribed fire activities follow all agency and departmental policy as well as all air quality and smoke management air requirements; and
- Ensure that all fuels management activities are conducted according to NEPA and individual project compliance guidelines.

3. Five-Year Plan for Wildland Fire Management Program

Yellowstone's five- year plan for the fire management program will focus on hazardous fuel reduction projects within the wildland- urban interface of developed areas and at backcountry cabins. Appendix L lists these projects by projected

implementation year, FMU, number of acres to be treated, and compliance status. Provided sufficient funding is secured for implementation and compliance, Yellowstone may implement at least one of two phases for a prescribed fire in the critical boundary area at Northeast Entrance in the Northern Range FMU within the next five years.

4. Historical Role of Fire

Natural fires have been a part of Yellowstone's environment for thousands of years prior to the arrival of modern humans (Romme and Despain 1989). Written fire records date back to 1870 and significant fires are noted in early annual Superintendents' reports. However, fire statistics from 1872 through 1899 are very sketchy with only large fires being reported. Record- keeping improved somewhat at the beginning of the nineteenth century. From 1900 through 1929, approximately 374 fires burned 11,670 acres. Reliable fire statistics have been kept from 1930- 2004. Lightning- caused fires numbered 1,573, while 761 fires were human- caused.

During the 1988 fire season, 50 fires burned approximately 800,000 acres in the park. (This assessment of number of acres burned was based on satellite imagery taken during October 1988. Subsequent GIS mapping of fire perimeters indicates that approximately 1.1 million acres were affected by the 1988 fires including downfall.) Five of these fires originated outside Yellowstone and burned over 500,000 acres within the park. The human- caused North Fork fire was the largest of these fires and began on the Caribou- Targhee National Forest to the southwest of the park. Despite undergoing an aggressive initial attack, this fire burned extensively across the central plateau, threatening the town of West Yellowstone, Montana, and the developed areas of Old Faithful, Madison, Canyon Village, Norris, Mammoth, and Tower- Roosevelt.

Four fire history studies have been conducted in Yellowstone. One study concentrated on the sagebrush and grasslands of the northern range (Houston 1973). Another study was conducted on the Little Firehole River watershed (Romme 1979) on underlying rhyolitic soils. A third study reconstructed the fire history of a 320,000 acre study area located on the subalpine plateaus in the south- central part of the park (Romme and Despain 1989). A fourth study assessed fire history on andesitic soils in the northeast portion of the park (Barrett 1994). Fire history studies have also been conducted in Montana and Alberta, Canada (Arno 1980), in similar fuel types. All studies support the conclusions that fire has had a substantial influence on plant community succession and that fire has long played an ecological role in the environment.

Houston's study (1973), on the edge of the low- elevation sagebrush steppe, sampled 34 trees with an average age of 322 years. Analysis indicated that the average mean interval between fires was 53- 96 years, with mean intervals for individual trees ranging from 36- 108 years. The mean adjusted fire interval for the study area was 20- 25 years, with eight to ten large fires burning significant acreage over the past 300

to 400 years. Barrett (1994) found a comparable 30- year mean interval in low-elevation Douglas fir communities adjacent to sagebrush/grasslands on the northern range. The fire history of Yellowstone has been influenced by humans, particularly in the lower elevation, shorter- interval fire regimes. Fire suppression efforts, coupled with the lack of intentional ignitions often attributed to Native American burning, resulted in a relatively fire- free period from 1886 to 1987 on the northern range. The largest fire on the northern range prior to 1988 burned approximately 460 acres.

The fire history studies summarized by Arno (1980) for the subalpine forests of Montana and Alberta reported fire frequencies ranging from 63 to 153 years. Romme and Despain's (1989) study of 320,000 acres in Yellowstone's subalpine forests showed fire frequencies of approximately 300 to 400 years. This study also reported that less than 10 percent of the watershed had burned in the previous 350 years. The study concluded that most of the study area was an even- aged stand and had last burned between 1690 and 1740. Barrett (1994), on the other hand, found a 200- year mean fire return interval in lodgepole pine forests underlain by volcanic andesitic soils—nearly half the length found on the less productive rhyolitic soils. These studies suggests that a principal reason for the differences between the fire frequency estimates is fuel accumulation as influenced by climate and productivity of the underlying soils types.

Romme and Despain (1989) evaluated Yellowstone's fire history in light of the 1988 fires. They suggested that fire suppression efforts since 1886 may have only postponed the fires of 1988 by a few decades. They noted that large fires might have occurred during the dry summers of 1949, 1953, 1960, or 1961 without fire suppression efforts. They further noted that fire behavior, in terms of heat release, flame height, and rate of spread, were probably similar to the fires that burned a significant percentage of the study area in the early- to mid- 1700s. They concluded that the 1988 fires represented a nearly natural event. The fires were mainly the result of extremely warm, dry, and windy weather combined with an extensive forest cover of highly flammable fuels, mainly lodgepole pine.

5. Specifics of Wildland Fire Management Situation for Fire Management Units

a. Historical Weather Analysis

Average annual precipitation totals range from a high of 32.64 inches at the South Entrance to a low of 15.45 inches at Mammoth. High elevations and associated long winters produce significant snowfall which makes up the majority of precipitation received in Yellowstone. Snowfall totals range from a high of 244 inches at the South Entrance to a low of 75 inches at Mammoth. Snowpack begins in early October for elevations above 9,000 feet and in late October for elevations around 7,000 feet. The snowpack melts in late May at the 7,000 foot level and in early July at 9,000 feet. The

average duration of snowpack is 213 days at 7,000 feet and 271 days at 9,000 feet (Despain 1990).

Periods of below- average snowpack and precipitation are common in Yellowstone, and this influences the fuel moisture content of spring grass, duff, and litter at lower elevations as well as the 1000- hour fuel moisture content throughout the fire season. When a normal snowpack is received and snowmelt is gradual throughout the spring, fuel moistures start at much higher levels, and a very dry summer is required to significantly reduce these fuel moisture levels.

b. Fire Season

The normal fire season is June 15- September 30, based on historical weather and fire occurrence statistics as analyzed by FIREPRO, an automated fire management budget planning and programming system developed by NPS. Critical factors influencing the fire season include the number of summer lightning storms and the timing and amount of summer precipitation. Since the majority of fires are started by lightning, the periods in spring before the grasses green and in the fall after dormancy and before snowfall begins, are normally periods of few fire starts. Summer drought conditions and frequent lightning storms can result in many fire starts, with the potential for large acreages to burn.

The typical fire weather pattern is one where adequate amounts of precipitation fall during the months of June through September. Although live fuel moisture content of all vegetation drops as the season progresses, dead fuel moistures remain high as a result of frequent precipitation. Lightning- caused fire starts occur across this fuel moisture continuum, but fire activity is constrained by live and dead fuel moisture content. Fire spread, when it occurs, is limited to smouldering and creeping ground fire with occasional torching of single or small groups of trees.

A proportional increase in lightning- caused fire starts and increased fire activity takes place during the infrequent occurrence of dry conditions within the June- September period. Depending on the timing and degree of departure from typical moisture conditions, fire spread ranges from short- duration crown runs to independent stand- replacing crown fire. During such years, it is common for fires to burn more than 1,000 acres each, depending on the availability of fuel types.

c. Fuel Characteristics In Relation to Fire Behavior

Fire behavior is dependent on many different environmental factors, including fuels, weather, and topography. Because plant communities reflect complex interactions of biological and physical factors such as seral stage, soils, moisture, temperature, slope, aspect and elevation, plant communities are good indicators of potential fuel combustibility and fire behavior.

Despain (1973) classified all the major forested cover types in Yellowstone by species and stand structure, and described the associated fire behavior for each cover type (Appendix M). Cover types (e.g., LP for lodgepole pine, 0 for a young stand = LP0) can be easily and quickly identified in the field and are general indicators of fuel load, dominant plant species, and the time elapsed since the last disturbance agent (e.g., wildland fire, wind, mudslide, or avalanche). Stand characteristics of each cover type play a significant role in fire behavior. The forests in Yellowstone are singularly lacking in shrubs; understory fuels are predominantly young trees.

Other than seral lodgepole pine cover types (LP0- LP3) which are most common in Yellowstone, there are climax lodgepole, spruce- fir, whitebark pine, and Douglas-fir cover types. Generally the most flammable cover types are older which contain some element of spruce- fir. Older stands have accumulated downed logs and thick litter layers on the forest floor, and have a well- developed understory of shade tolerant trees and shrubs. The fuels on the ground promote ignition and fire spread while the understory forms a "ladder" which provides the potential for a ground fire to reach into the canopy. In Yellowstone the LP3 (old- growth, mixed- canopy lodgepole pine and spruce- fir) and SF (climax spruce- fir) may be 300 years or older and particularly prone to ignition by lightning (Renkin and Despain 1992).

While cover types describe existing stand structure and are more representative of forested communities, habitat types that describe vegetation communities based on the occurrence of certain indicator species are useful in describing potential climax vegetation (Pfister et al. 1977, Steele et al. 1983, Despain 1990). However, habitat types do not adequately reflect the seral stage currently occupying the site. Habitat types are very useful in attributing fuel model to nonforested communities, and together with cover type are ideal in describing the stand age and successional trajectory of forested communities.

While cover types and habitat types have been used to describe the vegetation in an 8- million acre area throughout the GYA, wildland fire staff also use a system of fuel models which are standardized throughout the United States (Anderson 1982). There are thirteen fuel models that range from grasslands to forests. In Yellowstone, most wildfires burn in fuel models 8 and 10, which represent conifer forests with varying fuel loads. For example, a mature lodgepole stand (LP2) generally fits fuel model 8 while older stands (LP3) fit fuel model 10 because they have accumulated more fuels. Other fuel models (e.g., 1 and 3) describe grass and shrublands common to the park. Fuel models represent the standard approach to model and predict fire behavior and rates of spread. Successful crosswalks have been employed to reassign fuel models to forested cover types and nonforested habitat types for mapped vegetation communities in the Yellowstone region.

The majority of lightning- caused fires that occur in the subalpine forests of Yellowstone exhibit fire behavior that can be categorized under a matrix of scenarios. After ignition, a snag smolders for several days and then burns out either because live, dead, and duff fuel moistures are too high to support sustained

combustion, or because fuels are too discontinuous both horizontally and vertically to promote fire spread. Under a different scenario, sufficient ground and ladder fuels (low branches, small trees, or shrubs growing at different levels) in the understory are present, dry conditions exist, and fire can move into the canopy whether influenced by high winds or convective currents that result from active combustion. Depending on the forest type present and in conjunction with fuel moisture, weather, and topography, fires can grow in size by isolated to frequent torching and spotting (transport of burning material by wind and convection currents), or in the extreme case, by spreading from tree crown to crown, independent of the ground. In any fire event, crown fire behavior represents the main mode of fire spread. Fires in the subalpine forests of the Yellowstone region seldom experience significant spread through surface fuels only.

The park has 2,093,638 acres of burnable vegetation and 100,961 acres of unburnable material such as rock and water. In an average year, approximately 22 fires are ignited in Yellowstone by lightning. Of these, 83% never reach more than 0.5 hectare (1.2 acres) in size and 94% never burn more than 40 hectares (100 acres).

Table 1 lists the major vegetative cover types by number of acres, fire regime, and condition class. An historical (natural) fire regime classifies the role that fire would play in the absence of modern human intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Table 2 lists five historical fire regimes classified by the average number of years between fires (fire frequency), combined with the severity of the fire on the dominant overstory vegetation (Hardy et al. 2001, Hann and Bunnell 2001). Characteristic vegetation and fuel conditions are considered those that occurred within the historical regime. Uncharacteristic conditions are invasive species (e.g. weeds, insects, and diseases), "high graded" forest composition and structure (e.g. large trees removed in a frequent surface fire regime), or repeated annual grazing that maintains grassy fuels across relatively large areas at levels that will not carry a surface fire. The amount of departure is based on comparison of a composite measure of vegetation characteristics, fuel composition, fire frequency, severity and pattern to the central tendency of the historical fire regime. The fire regime condition class (FRCC) in Table 3 classifies the amount of departure from the natural historical regime (Hann and Bunnell 2001).

d. Fire Regime Alteration

With the exception of aggressive suppression on the northern range in the mid-twentieth century, suppression of naturally- ignited fire in the Yellowstone's forested habitat types has not resulted in significant increase in fuel loads. Records indicate that fire suppression efforts and the lack of intentional ignitions in the northern range from 1886 until 1987 were almost completely successful in excluding fire from the Douglas fir, sagebrush steppe, and aspen communities, primarily to protect Ft. Yellowstone at Mammoth Hot Springs.

Table 1. Major Vegetative Cover Types Parkwide				
Cover Type	**Number of Acres**	**Fire Regime**	**Condition Class**	**Within Normal Range of Condition Class I or Reasons for Departures from Condition Class I**
Lodgepole Pine	1,348,523	V	1	Normal range
Whitebark Pine	267,081	V	1	Normal range
Douglas- fir	124,800	III	1,2	Reduced fire frequency
Spruce/Fir	67,676	V	1	Normal range
Grass/Sage	281,682	II	2	Reduced fire frequency
Aspen	3,876	IV	1,2	Reduced fire frequency/ unsuccessful postfire regeneration
Unburnable	100,961	N/A	N/A	

Table 2. Description of Historical Fire Regimes	
Fire Regime	**Description**
I	0- 35 year frequency and low to mixed severity (surface fires most common) less than 75% of the dominant overstory vegetation replaced)
II	0- 35 year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced)
III	35- 100+ year frequency and mixed severity (less than 75% of the dominant overstory vegetation replaced)
IV	35- 100+ year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced)
V	200+ year frequency and high (stand replacement) severity

Table 3. Description and Potential Risks of Fire Regime Condition Classes		
Fire Regime Condition Class	**Description**	**Potential Risks**
Condition Class 1	Within the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	• Risks similar to those occurring prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation/fuel characteristics. • Composition and structure of vegetation and fuels are similar to natural (historical) regime. • Risk of loss of key ecosystem components (e.g. native species, large trees, and soil) is low.
Condition Class 2	Moderate departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	• Risks moderately departed (more or less severe). • Composition and structure of vegetation and fuel are moderately altered. • Uncharacteristic conditions range low- moderate. • Moderate risk of loss of key ecosystem components.
Condition Class 3	High departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	• Fire behavior, effects, and other associated disturbances highly departed (more or less severe). • Composition and structure of vegetation and fuel highly altered. • Uncharacteristic conditions moderate to high. • High risk of loss of key ecosystem components.

e. Control Problems and Dominant Topographic Features

Because the vast majority of Yellowstone is a broad plateau with continuous fuel beds, there is a potential for large fires to burn across the landscape. A few natural barriers to fire such as the ridge from Electric Peak south to Mt. Holmes, Yellowstone Lake, and the Absaroka Mountains along the eastern boundary of the park are likely to prevent the spread of a low- to moderate intensity fire. During the large- scale 1998 Yellowstone fires, spotting occurred over two to three mile distances and over these natural barriers. In addition, all of the FMUs contain vast and remote acreages, making accessibility difficult for fire management responses.

f. Other Elements of Environment Affecting Fire Management

Drought and strong wind events associated with dry, cold fronts and dry lightning storms can result in large fire spreads. During the 1988 fires, eight major cold fronts come through the park, contributing to significant fire intensity and growth.

IV. WILDLAND FIRE MANAGEMENT PROGRAM COMPONENTS

A. General Implementation Procedures

Under an approved FMP that meets NEPA compliance, a national park unit has the flexibility to implement a full range of management responses that include suppression of wildfires at all levels including aggressive initial attack, wildland fire use and prescribed fire to achieve resource benefits under the appropriate management response (AMR). The AMR for all human- caused fires will not include resource benefits as a consideration, and these fires will be declared wildfires and suppressed. Wildland fires that are not human- caused will be managed through the AMR based on identification of resource management needs and constraints, reflect a commitment to safety, be cost- effective, and accomplish desired objectives while maintaining the versatility to vary in intensity as conditions change. Implementation of wildland fire management components must be consistent with fire management capabilities and should consider the current and predicted conditions affecting fire behavior.

Figure 4 on page 42 is the National Wildfire Coordinating Group umbrella flowchart from the *Implementation Guide* that illustrates the pathways to determine the fire management strategies for humans- caused, fire, wildland fire use, and prescribed fire.

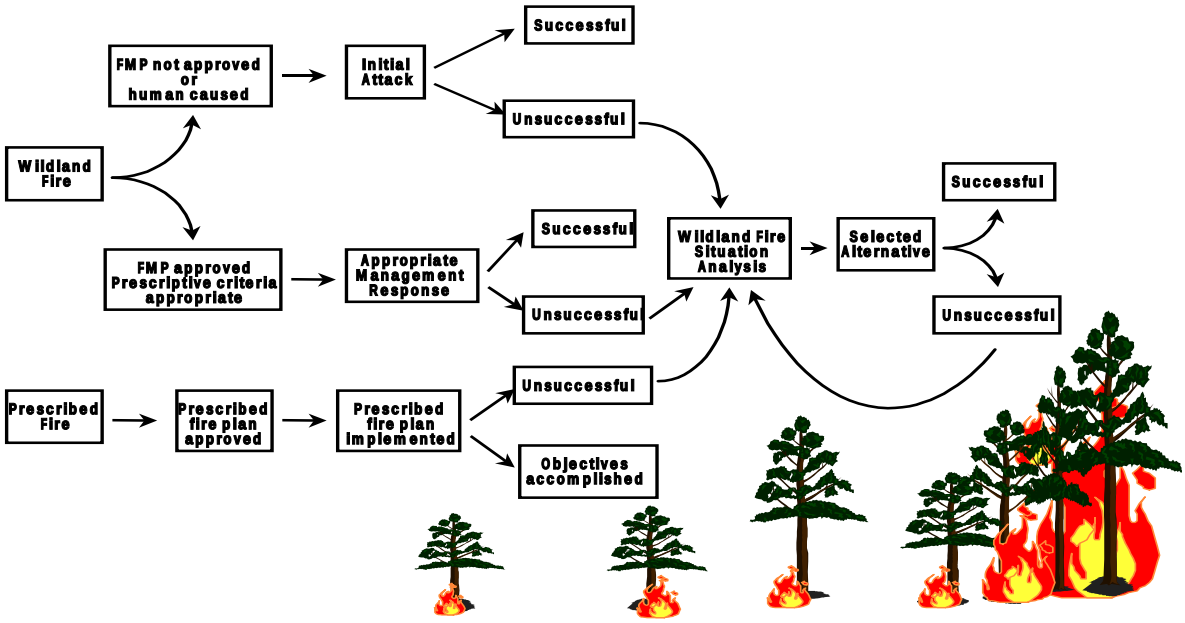

Figure 4. Pathways to determine the fire management strategies for human-caused fires, WFU, and prescribed fires.

B. Wildland Fire Implementation Plan

A WFIP will be initiated for all wildland fires based on requirements outlined in Chapter 4 of the *Implementation Guide*, which contains all of the required forms (http://www.fs.fed.us/fire/fireuse/wildland_fire_use/ref_guide/). Table 4 on page 44 lists the WFIP stages and assessment components from the 1998 *Implementation Guide*. The completion timelines for these stages are based on a February 2005 revision to this guide. The full WFIP includes the following three distinct stages plus a periodic fire assessment.

- Stage I: Initial Fire Assessment
- Stage II: Short- Term Implementation Actions
- Stage III: Long- term Implementation Actions
- Periodic Fire Assessment

Stricter planning and documentation requirements exist for management of WFU fires. Progressive development of these stages will occur for WFU for resource benefits or where initial attack is not the selected response. Resource objectives, fire location, cause, conditions of fuel continuity, current fire activity, predicted weather and fire behavior conditions and risk assessments results will indicate when and which of the three WFIP stages must be completed. Where the FMU development

determines suppression is the only appropriate response, the requirement for a decision checklist as part of the Stage I analysis is considered to be met. Subsequently, the Stage I analysis may often be satisfied at the programmatic level through determinations made by combinations of values to be protected and/or fire behavior thresholds. Only the most complex fire being managed for resource benefits requires completion of all stages of a WFIP.

1. Stage I: Initial Fire Assessment

Stage I: Initial Fire Assessment is necessary to establish the foundational information critical to manage the fire. It documents the current and predicted situation, all appropriate administrative information, and aids managers by providing them with decision criteria to make the initial decision whether to manage a wildland fire for resource benefits or to take suppression action. *Preplanned decisions* based on historical fire behavior indices should be considered to most efficiently aid in *Stage I* decisions requiring the AMR. Fire managers will use these strategies for expediting the decision- making process when determining whether to respond to an initial action as an emergency or if wildland fire ignition will be used for resource benefit.

Stage I consists of four specific components: *Strategic Fire Size- Up*, *Decision Criteria Checklist* (Initial Go/No Go Decision), *Initial Implementation Actions*, and *Periodic Fire Assessment*. All reported wildland fires receive a *Strategic Fire Size- Up* that includes information to assess the initial fire location, size, conditions, weather behavior, and availability of fire management resources. The *Decision Criteria Checklist* provides the Superintendent with evaluation criteria to determine if the current wildland fire meets criteria to be managed for resource benefits. Stage I actions must be completed 8 hours after a confirmed fire detection report has been filed and the Strategic Fire Size- Up has been completed. The Fire Management Officer (FMO) will be responsible for completing the forms for the *Fire Situation* and *Decision Criteria Checklist*.

2. Stage II: Short-Term Implementation Actions

This stage represents the continuation of management for resource benefits. It includes validation of *Short- Term Implementation Actions* as a decision. This stage will provide predictions of where the fire may go, how intense it may burn, how fast it may spread, what the necessary short- term management actions are, and if long-term management actions need to be addressed immediately.

A risk assessment chart provides the Superintendent and staff with an aid to determine whether Stage III Long- Term Assessment and Implementation Actions need to be developed, documented, and implemented immediately, or if the fire can be managed through the established short- term implementation actions until indicated otherwise by the *Periodic Fire Assessment*. For many wildland fires in the

Table 4. Wildland Fire Implementation Plan (WFIP) Stages Under the Appropriate Management Response (AMR)					
WFIP Stage	**Planning and Assessment Element**	**Requirement Status*** *Key: 1=mandatory 2=mandatory, but can be preplanned 3=optional 4=completed if Stage II or Periodic Fire Assessment, Par 2 indicate need (can be preplanned in FMP) 5=completed if fire exceeds management capabilities 6=completed if Periodic Fire Assessment, Part 1 indicates need NA=Not Applicable			**Maximum completion timeframe**
		Initial Attack	Other Suppression-oriented Appropriate Management Responses	Fire Use actions	
Stage I: Initial Fire Assessment	Initial Implementation Actions	1	1	1	As soon as possible
	Decision Criteria Checklist (Initial GO- NO- GO Decision)	3	1	1	8 hours after confirmed fire detection and Strategic Fire Size- Up
Stage II: Short- term Implementation Actions	Short- Term Fire Behavior Predictions and Risk Assessment	3	1	1	48 hours after need indicated by WFU Management Assessment
	Short- term Implementation Actions	2	1	1	
	Complexity Analysis	3	1	1	
	Stage III Need Assessment Chart	NA	1	1	
Stage III: Long- Term Implementation Actions	Maximum Management Area (MMA) Definition	3	4	4	7 days after need indicated by WFU Management Assessment
	Fire Behavior Predictions	3	4	4	
	Long- Term Risk Assessment	3	4	4	
	Long- Term Implementation Actions	3	4	4	
Periodic Fire Assessment	Part 1: Revalidation	NA	1	1	As part of all stages and on assigned frequency thereafter
	Part 2: Stage III Need Assessment Chart	NA	1	1	
Wildland Fire Situation Analysis (WFSA)		5	5	6	Before implementing new strategy

park, fuel continuity and spread potential will be low. In other situations, environmental conditions will preclude active burning and spread. For these types of wildland fires, immediate completion of Stage III of the WFIP will not need to occur until specific thresholds are reached. These thresholds are assessed subjectively on this chart or through the continued assessment provided by the Periodic Fire Assessment. Stage II actions must be completed within 48 hours after it has been determined to move to this stage as indicated by the Periodic Fire Assessment.

3. Stage III: Long-term Assessment and Implementation Actions

Stage III provides *Long- Term Implementation Actions* necessary to manage the wildland fire to accomplish identified objectives. This stage will provide a definition of the ultimate acceptable geographic size of the fire by determining *a Maximum Manageable Area* (MMA). The MMA will consider long- term fire behavior predictions and long- term risk assessment. It will assess the likelihood of the fire reaching the MMA perimeter, and will document those operational management actions necessary to manage long duration fires that will need mitigating measures to strengthen and defend the MMA. This stage details operational activities and documents the planning completed to ensure adequate mitigation actions have been developed. These actions will provide the best protection against fire activity exceeding acceptable limits.

Mitigation actions are those on- the- ground activities that will serve to increase the defensibility of the MMA, check, direct, or delay the spread of fire, and minimize threats to life, property, and resources. Mitigation actions may include mechanical and physical non- fire tasks and specific fire applications. Their purpose is to construct firelines, reduce excesssive fuel concentrations, reduce vertical fuel continuity, create fuel breaks or barriers around critical or sensitive sites or resources, create *blacklines* through controlled burnouts, and limited suppression actions to limit fire spread and behavior.

Completion of this stage is determined (triggered) by either the Stage III *Need Assessment Chart* (WFIP Stage II) or through the Periodic Fire Assessment, Part 2. Stage III should be completed within 7 days from when the Periodic Fire Assessment indicates the need. Once Stage III has been completed, the full WFIP will have been developed.

4. Periodic Fire Assessment

For each WFU action, the Superintendent is required to periodically affirm the capability to continue management of the fire. This stage is intended to prevent the unchecked escalation of an individual fire situation or the total fire management situation without evaluation and adequate planning. A checklist of information must be completed to accomplish two purposes. First, this checklist affirms the appropriateness of continued management of the fire for resource benefits.

Secondly, this checklist confirms the decision pertaining to the need to develop and document the WFIP Stage III. The Periodic Fire Assessment consists of three components: a *Revalidation* of the appropriateness of continued management for resource benefits, an assessment of the need to escalate from WFIP Stage II to Stage III, and a signature table that affirms the Superintendent's concurrence.

C. Wildland Fire Suppression

1. Range of Potential Fire Behavior

See *Historical Role of Fire* (Section III, D, 4, on page 35 and Appendix M).

2. Preparedness Actions

a. Fire Prevention Program

The fire prevention program is designed to determine the human- caused fire threat to Yellowstone and to define specific actions to reduce that threat. The wildfire prevention efforts are directed toward ignitions that pose the greatest potential for causing unacceptable damage or loss.

During the planning process for wildfire prevention, it is necessary to assess and identify all potential threats and problem areas. Prevention analyses for Yellowstone are based on RM- 18, Chapter 11, and Yellowstone's 1992 Fire Prevention Action Plan (Appendix N). The 1992 Fire Prevention Action Plan analysis evaluated risks, hazards, and values for each area of the park. Separate overlays were prepared to compare the potential for an ignition (risks) with the potential to burn after ignition (hazards) along with the values threatened by a wildfire (values). The information on each overlay was compiled and transferred to a single park base map which was digitized into the park's GIS files for permanent storage.

The goal of the fire prevention program is to identify the cause of each fire and to minimize human- caused fires through the following objectives and general actions.

(1) Objectives

- Define the human- caused threat and determine specific actions to reduce that threat.
- Integrate the prevention message into all visitor contact messages.
- Increase interagency and community awareness of the fire prevention program.
- Improve relationships with interagency cooperators and local communities through the fire prevention program.
- Increase employee awareness and involvement in the fire prevention program.

(2) General Actions

The general actions are designed to address the major causes of human- caused fires in Yellowstone (in the last ten years). These causes are unattended and escaped campfires, fires resulting from smokers, and powerline fires.

- A fire prevention message addressing campfires and smoking will be incorporated into the backcountry and special use permitting system and made available to each camper. This message will be posted in each picnic area and campground and at each trailhead registration box. This message will also be incorporated into the information packet distributed at each entrance station and visitor center.
- The fire prevention messages will be translated into the most commonly used foreign languages and incorporated into the information packets distributed to foreign visitors at entrance stations and visitor centers.
- Daily notification of the fire danger levels will be posted at entrance stations, trailheads, and visitor centers.
- All park and concession employees will be given the opportunity for fire prevention awareness education.
- A program will be developed with Northwestern Energy to reduce fires caused by powerlines. This program will include burying powerlines, routinely inspecting the powerline corridor after high wind events, and clearing the right- of- way of hazard trees.
- All human- caused fires will be declared wildfires and suppressed. The fire prevention program will give the highest priority to protection of human life.

Preparedness activities are carried out prior to a fire occurrence to ensure that the appropriate response to that fire can be accomplished. Preparedness activities include budget planning, equipment acquisition, equipment maintenance, equipment inventory, recruitment, and training. The objective of the preparedness effort is to have a well- trained and well- equipped fire management organization in place to manage all fire situations within Yellowstone. Preparedness activities are detailed in RM- 18, Chapter 7. They are covered by normal park operating funds and supplemented with FIREPRO funding.

The fire season, as determined by the FIREPRO analysis during preparedness planning, is from June 15th through September 30th. Preparedness efforts are to be accomplished outside the normal fire season dates. When periods of high fire danger occur outside the normal fire season dates, the appropriate action will be taken, and justification for funding such actions will be sent in writing to the Regional FMO.

The scope of the helitack program includes a quick Incident Attack for wildland fires from human- caused, downed powerlines, structures in developed areas, and critical boundary areas that do not meet the criteria for wildland fire use.

(3) Annual Schedule For Preparedness Actions Including Training

October 1 - April 30

- The FMO will critique the fire prevention program along with the Fire Management Committee (see Section V, A, 1.) and park staff to incorporate recommendations for wildland fire management implementation by the next fire season.
- The FMO will meet with interagency cooperators to critique the GYA fire prevention program during the past fire season and determine the percentage of the budget dedicated to fire prevention efforts. Any new techniques, information, or procedures that have proven successful in reducing human- caused fires in other areas will be included for the upcoming fire season.
- Interagency and cooperative agreements will be reviewed on an annual basis.
- Plans for any prescribed fires to be implemented during the upcoming fire season will be developed, reviewed by the Fire Management Committee, and sent to the Superintendent for approval.
- The FMP will be reviewed and updated by the Superintendent by April 30 of each year.
- The FMO will ensure that necessary fire prevention information is included in the park newspaper.
- Winter snowpack, water level, and drought information will be monitored for potential impacts to Yellowstone's fire season.
- Seasonal personnel vacancy announcements will be issued and personnel will be recruited.
- Meetings will be held with the Department of Interior Aviation Management Division, a branch of the National Business Center, to review and complete helicopter contract requirements and set the date for inspection of the contract helicopter.
- Necessary maintenance on all fire equipment will be accomplished prior to each fire season.
- All fire equipment will be inventoried and the equipment location list updated.
- Portable pumps and chainsaws will be tested and operational.
- All initial attack/helitack support vehicles will be inventoried and equipped.
- Fire weather observations will begin at the Mammoth weather station when the snow melts around the station area to follow the danger trend for the upcoming fire season.
- The FMO and staff will implement the fire prevention program within Yellowstone. They will investigate all human- caused fires, assist the law enforcement staff in prosecuting responsible parties when necessary, and complete fire reports and case incident reports. All fire prevention information will be provided through the Interpretation and Ranger divisions. The FMO and staff will monitor visitor response to the current fire prevention program.

May 1 - September 30

- A state of readiness will be maintained as outlined in the Step- Up Staffing Plan.
- All units in the GYA coordinate fire prevention efforts throughout the summer fire season as fire danger warrants. These efforts include coordinated fire restrictions and fire prevention messages in National Forests and National Parks that may restrict open campfires in wilderness or backcountry areas and allow open campfires only in frontcountry or developed campgrounds. Restrictions may include restricting smoking to vehicles and developed campgrounds and a ban on all type of fireworks.
- Seven- day- a- week fire management operations will be initiated as necessary.
- Equipment will be issued to all seasonal personnel and training completed.
- The helicopter contract helicopter will be inspected prior to June 15.
- Fire lookouts will begin operation.
- Operation of the remaining fire weather stations will begin.
- Sampling and weighing of live and dead fuels and tracking of 1000- hour fuel moistures will continue.
- Fire situation reporting will begin and the reports will be entered onto the NPS fire update database.
- The seasonal training schedule will be written and firm dates and location of training will be determined.
- Refresher training for the seasonal helitack crew will be completed prior to June 15.

b. Fire Readiness of Equipment and Supplies

A central fire cache is located at park headquarters in Mammoth Hot Springs. A one hundred person fire cache is maintained in addition to supplying each district with ten complete individual firefighter initial attack packs and tools. Mark III portable pumps will be pre- positioned at Bechler Ranger Station with additional pumps located at Mammoth. An adequate supply of radios and chainsaws will be maintained at Mammoth.

c. Fire Weather and Fire Danger Monitoring

(1) Weather Stations

Yellowstone maintains seven fire weather stations and three RAWS as described for the FMUs, according to the standards defined in the Fire Weather Observers Handbook. These stations are located in areas that represent all fuel types, elevations, and topographic locations found in the park. Daily fire weather observations are entered into Weather Information Retrieval and Management System (WIMS) beginning May 1 at the Mammoth Station, and continue until snowfall begins in the fall. The WIMS archives indices under the fuel model G3P2 (NFDRS fuel model G, representing dense conifer stands where a heavy buildup of downed tree material has accumulated; a slope class of 3, 41- 55 percent; herbaceous

perennial grasses; and a climate class of 2, defined as receiving deficient rainfall in summer).

The fire management staff monitors the daily fire danger indices, fire weather forecasts, and local and national situation reports to remain informed and prepared to manage all fire situations throughout the fire season. The situation reports are posted daily in the Fire Management Office and current fire danger information is provided to the District Rangers, Chief Ranger, and Communications Center.

(2) National Fire Danger Rating System

Yellowstone uses the National Fire Danger Rating System (NFDRS) (Deeming et al. 1977), which provides daily fire danger indices relating to potential and expected fire behavior. The NFDRS is a broad preparedness tool to estimate the "worst case" fire danger and fire potential by taking fire weather observations during the heat of the day. It evaluates the near upper limit of the behavior of fires expected in a rated area during the rated period. The indices used include the Burning Index (BI), Energy Release Component (ERC), 1000- hour timelag fuel moisture content, and Lightning Activity Level (LAL).

The BI is linearly related to the length of flames at the head of the fire and is derived from the rate of fire spread (SC) and the ERC in the flaming zone to provide a rating of the difficulty of containment of a wildfire. Wind is the critical and necessary factor in large fire spread, and the BI is a good indicator of probable worst- case conditions 24 hours in advance of an expected fire situation. However, the BI is very sensitive to wind and often overpredicts daily fire danger because most summer afternoons in Yellowstone are windy.

The ERC is related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a surface fire. The ERC calculations do not consider wind as a factor and can be used as a cross- reference indicator along with the BI. Since wind is not a factor in ERC calculations, ERC numbers become relatively stable and may be used for planning decisions 24 to 72 hours ahead of an expected fire situation. The ERC is also a good indicator of long- term drying because dead and live fuel moistures are factors in the calculations.

The NFDRS does not predict how every fire will behave but is intended to provide guidance for daily and long- range planning for Yellowstone's fire management program. It is not designed for nor is it adequate for predicting real- time fire behavior. Real- time fire behavior can be observed directly in the field while predictions can be estimated by five methods: (1) nomograms found in General Technical Report INT- 30; (2) the BEHAVE program, an interactive computer program for fire behavior projections; (3) the tables in S- 390, Fire Behavior Field Reference Guide; (4) the Rare Event Risk Assessment Process that provides fire spread and risk analysis; and (5) FARSITE (Fire Area Simulator), a modeling approach that projects fire perimeters and behavior for long- term fire assessment.

Fire managers in Yellowstone use all the available tools to predict fire behavior for planning purposes.

Real- time fire behavior predictions with area and perimeter map growth projections will be calculated for all new fire starts. Fire behavior predictions will also be calculated for all active wildfires and WFU fires. *Active* is defined as a burning period in which fire perimeter growth is expected to increase by 10 percent or 10 acres, whichever is less. Current weather observations will be used and spot weather forecasts will be requested when determined necessary and utilized for predictions into the next burning period. These predictions will provide the fire management staff with the fire's current rate of spread, heat per unit area, flame length, fireline intensity, spotting distance, and the fire's area and perimeter in acres and chains (a measurement distance of 66 feet).

Figure 5 from the *Implementation Guide* illustrates a NFDRS firefighter pocket guide used to assess fire danger by accessing and evaluating historical weather data. The guide shown is representative of most fire seasons in the western U.S. The historical time period maximum, average, and 97th percentile levels (or other applicable percentile level) for that fire danger indicator can be created and formatted onto the color card. Significant past fires can be marked on the chart to provide an indicator of conditions present during that fire. The final chart then provides a quick visual reference that can be formatted as a pocket card and distributed to firefighters, aerial observers, monitors, etc., or can be enlarged to wall- size for quick office reference. The information revealed by this card can be used as the source of input for the decision criteria checklist, or for other input information described in later WFIP stages. Instructions for creating and using this card are available from the Intermountain Fire Sciences Lab in Missoula, Montana.

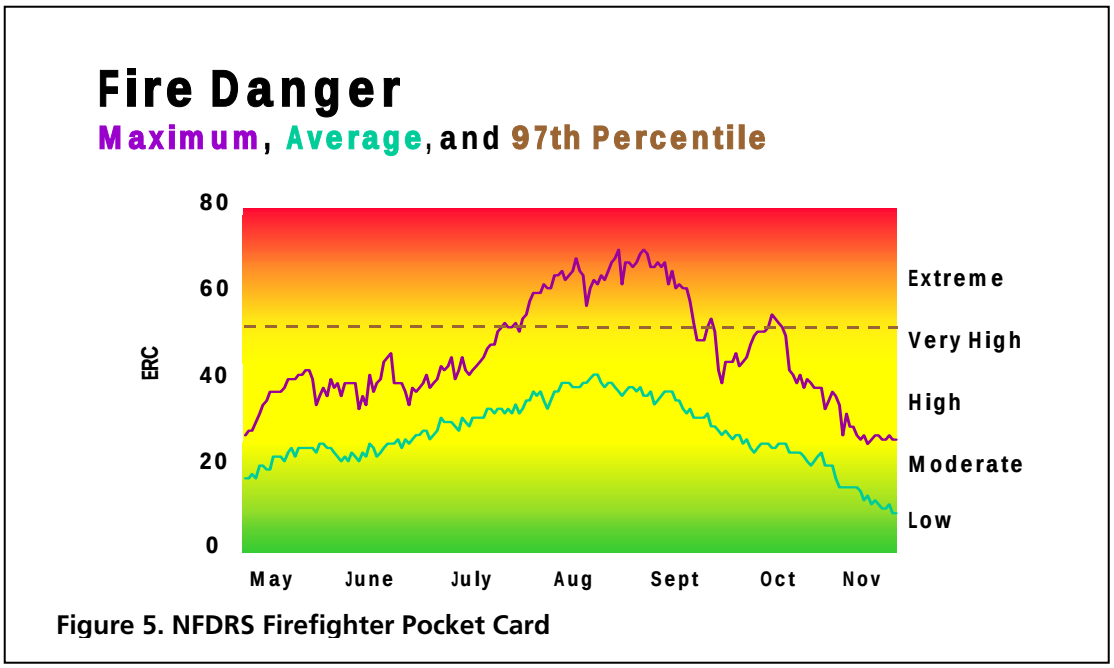

Figure 5. NFDRS Firefighter Pocket Card

d. Step-Up Staffing Plan

Yellowstone's Step- Up Staffing Plan (Appendix O) identifies the five staffing class levels, corresponding incremental preparedness actions, and assigned resources needed to meet the predicted increasing or decreasing fire danger. These generally correspond with the five established adjective classes of fire danger shown above in Figure 5 (1, *Low*; 2, *Moderate*; 3, *High*; 4, *Very high*; 5, *Extreme*).

The staffing class level is determined by graphing all BI predictions that have been archived in the WIMS at the Mammoth Station derived from NFDRS fuel model G. The 90th percentile and a BI of 67 are the cutoff points between *High* fire danger (staffing class level 3) and *Very high* fire danger (staffing class level 4). The preparedness actions needed during times of unusual or *Extreme* fire danger (staffing class level 5) caused by meteorological influences on the park's vegetative complex such as strong and/or dry winds, dry thunderstorms, or prolonged local or regional drought, are based on analyses of extreme fire seasons or periods of extreme fire danger within *Normal* fire seasons and are linked to the NFDRS BI index.

Historically, lightning- caused fires produce the most number of starts and burn the most acres. Therefore, the LAL will be used as a factor in the Step- Up Staffing Plan. The adjective rating and preparedness level action will be determined based on the worst- case BI value from the calculated staffing class. The Ignition Component is also used as a factor and is related to the probability of a firebrand producing a fire that will require suppression action. Both NFDRS and observed and predicted fire behavior projections will be used to complete the WFSA and WFU fires Daily Revalidation.

e. Severity Funding

It is neither reasonable nor prudent to program funds annually for the worst possible fire season. The normal funding for the fire management program is predetermined and is calculated to be adequate for managing fire activity 90 percent of the days during the fire season. While in staffing classes 1, 2 and 3, no additional funding is available from the region or national office to increase staffing or resource availability.

The remaining 10 percent of the fire season days are classified in the *Very high* to *Extreme* fire danger range (Staffing Classes 4 and 5). As stated in the *Red Book*, Chapter 9, two levels of severity funding exist when the park is in Staffing Class 4 or 5 to mitigate losses when abnormally severe fire conditions occur over an extended period. The Regional FMO has authorization limit for short- term (less than a week) severity funds up to $100,000.00. Appropriate activities for use of severity funds include hiring of temporary emergency firefighters, placing existing staff on extended tours of duty, increasing or initiating special detection operations, and hiring fixed- wing or rotary aircraft to accomplish necessary preparation. These

actions are aimed at ensuring prompt response with adequate forces should fires occur. The National Fire Director has the authority to allocate funds over $100,000.00 from suppression operations for specified preparedness activities. Severity funds are not provided to restore lost funding or raise funding levels but only to meet the needs during the period of abnormal conditions.

f. Fire Detection

The capability of detecting a wildfire is the key to all suppression activities in the park. All initial sightings of fires will immediately be reported via radio to the Fire Dispatcher (KOF 700 FOX) or to the Communications Center (KOF 700) after normal Fire Management Office hours. All pertinent information, such as location, size, fire behavior, fuel type, and proximity to structures or roads will be reported. All reported fires will be verified and investigated.

(1) Fire Lookouts

Yellowstone will operate the three traditional lookouts (Mt. Washburn, Mt. Holmes, and Mt. Sheridan) from June 15 until September 30, weather conditions permitting. Pelican Cone Lookout will be operated depending upon funding. The lookouts will be staffed seven days per week for the entire fire season from 0800 to 1700 hours. During periods of severe lightning storms, the duty hours will be extended as necessary.

(2) Aerial Detection Flights

These flights will be scheduled after periods of severe lightning when the fire danger is in the *Extreme* category or when normal visibility from the lookouts is hindered by smoke. Only experienced personnel will be used. A predetermined flight route will be established by fire management personnel using both the lookout reports of areas where intense lightning has occurred and BLM lightning detection occurrence maps.

(3) Fire Detection Patrols

Park rangers on road patrol and backcountry rangers on horseback or foot will look for new fire starts as part of their normal patrol routine. These rangers are instructed to take fire reports from visitors and concession employees and relay the pertinent information to the Fire Dispatcher. The park ranger may be requested to investigate fire reports in their district if a reported fire cannot be confirmed by one of the lookouts.

(4) Other Federal Agency Fire Detection Methods

The Gallatin, Caribou- Targhee, and Bridger- Teton National Forests, and Grand Teton National Park often conduct aerial detection flights over lands adjacent to Yellowstone. The smokejumpers stationed at West Yellowstone, Montana, also

conduct detection flights and often report fires seen in Yellowstone as they are on their way to fires on one of the national forests. The Yellowstone Fire Dispatch Office remains in close contact with area fire dispatchers and relays any information on new fires reported on other agency lands, as well as information regarding new fire starts in Yellowstone.

The business telephone numbers for reporting fires are listed in area phone directories. The park's Communications Center is operated 24 hours per day, 365 days per year. The business and home telephone numbers of all Region 1 fire management offices and personnel are listed in the Region 1 Mobilization Guide, which is provided to all interagency cooperators, park concessioners and area sheriffs' departments.

3. Pre-Attack Plan

The pre- attack plan is a comprehensive compilation of essential fire management information, which must be available in the park's fire management and/or dispatch offices (Appendix P). The pre- attack plan will be reviewed annually prior to the fire season and revised as necessary by the Fire Management Committee. The pre-attack plan will include evaluations of sensitive cultural and natural resource values and hazards based on recommendations with resource specialists both prior to the fire season (pre- season planning) and during the development of the WFIP. The Fire Management Committee will ensure that sensitive information on values and locations stated in the pre- attack plan are protected from inappropriate dissemination. The pre- attack plan will be maintained by the FMO.

4. Initial Attack

All wildland fires declared wildfires will receive an immediate and aggressive initial attack response consistent with firefighter and public safety and values to be protected. This strategy is applied as the result of Stage I analysis under the AMR process.

a. Information Used to Set Initial Attack Priorities

- Building list of historic structures with associated GIS maps
- GIS map of park developed areas and structures at each major location
- List of backcountry cabins with GIS map and coordinates
- Park fuel type maps
- GIS fire history map that delineates previously burned areas
- Park map of powerline corridors
- Maps of surrounding communities outside of park boundaries
- Map with coordinates of all sensitive archaeological sites
- Wetland maps
- Information and maps for federally listed species and sensitive species

Initial attack priority will be given to all park developed communities with specific priority to historic buildings. Park fire management operations staff will work closely with resource staff, maintenance staff, concessions staff and structural fire departments to prioritize individual structures and developed communities at risk. Interagency resources will be requested to assist in initial attack and extended attack suppression efforts as needed.

Park resource managers will identify and prioritize all sensitive park resources by GIS map location. Each resource will be described and suppression tactics will be developed with the fire management staff to best protect these resources from any suppression damage.

b. Dispatch

Dispatching involves the receiving of a fire report, gathering pertinent information, assessing and analyzing the situation, and assigning fire management personnel to carry out the desired action under the direction of the FMO. The fire dispatcher will monitor suppression progress, relay information to fire management staff and the affected District Ranger, process requests for additional manpower and supplies, and order aircraft support as needed. Suppression personnel will remain in radio contact with the Fire Dispatch Office during all phases of the suppression operations and report any significant events or fire status change.

The Yellowstone fire dispatch operation is responsible for submitting daily situation status reports to the NPS Fire Management Office in Boise, Idaho, and to the Region 1 Coordination Center in Missoula, Montana. Yellowstone has an interagency dispatch agreement with the Bozeman Interagency Dispatch Center for support in expanded dispatch situations such as additional dispatch personnel necessary to support large fires incidents requiring the assignment of IMTs. During periods of extreme fire danger and shortages of resources, calls are also made to the Wyoming Interagency Dispatch Center in Cody, Wyoming; the Caribou- Targhee National Forest dispatch office in Island Park, Idaho; the Grand Teton dispatch in Moose, Wyoming; and the Bridger- Teton dispatch in Jackson, Wyoming. Yellowstone's fire dispatch is linked to the national forests, including Region 1 Coordination Center, government e- mail systems, the Resource Ordering and Status System, and the Internet so the park remains in contact with interagency cooperators at all times.

Requests for all support resources needed in fire and other emergency operations will be processed through the Fire Dispatch Office. A current list of qualified personnel, pre- approved for initial dispatch by the Chief Ranger, will be maintained at the Fire Dispatch Office. Requests for interagency assistance will be processed through normal procedures, which include completing the Resource Order form. Dispatching requested resources for out- of- park assignment will be approved by the Chief Ranger after consultation with the FMO. For any additional personnel requested, the immediate supervisor and respective Division Chief will be contacted for approval.

The following steps will be taken:

- FMO will contact the affected District Ranger and dispatch initial attack personnel;
- FMO will assign a qualified Incident Commander (IC) and determine the appropriate suppression strategy to utilize;
- FMO will keep the Chief Ranger and affected District Ranger(s) informed and updated on the fire situation; and
- FMO will coordinate all suppression activity with the District Ranger and may request that district personnel initially attack a fire. The goal in all initial actions is to limit damage to values at risk, while minimizing the area burned and preventing escape of the fire.

The assigned IC will be responsible for all actions taken on the fire. The IC will inform the FMO of the fire situation as soon as possible after arrival on scene. If the fire behavior and complexity continues to increase, the IC may be replaced by a more qualified IC along with additional support personnel and supplies. The FMO is responsible for the selection of a replacement IC. If the fire threatens to exceed all initial attack capabilities, the Fire Management Committee will be convened and a WFSA will be prepared. The fire has now moved into the extended attack stage.

c. Criteria for the Appropriate Initial Attack Response Consistent with the Resource Management Plan Goals and Objectives

The criteria for choosing the initial attack response will be based on the AMR as described in the WFIP and will be determined by the FMO for routine fires that do not exceed initial attack and by the Fire Management Committee on fires that escape initial attack efforts or pose a serious threat to human life, property, and other areas of concern. A WFSA will be prepared on all fires that escape initial attack. The criteria will be based on firefighter and public safety and the values at risk. Sensitive resources will be secondary priorities.

d. Confinement as an Initial Attack Suppression Strategy

Confinement may be implemented as the initial attack action as long as it is not used to meet resource objectives. Confinement can be selected in lieu of WFU to maximize firefighter and public safety, minimize suppression cost and loss of low valued and commodity resource areas, and to maximize availability of critical suppression and management resources during periods of multiple starts and high fire danger associated with fire in highly valued resource areas.

Confinement can also be a strategic selection through the WFSA process when the fire is expected to exceed initial attack capability. When confinement is selected as the initial action, the same management process applies as for WFU decisions. A

long- term implementation plan may be developed and appended to the approved WFSA.

5. Extended Attack and Large Fire Suppression

a. Determine Extended Attack Needs

Extended attack occurs when a fire has not been contained or controlled by the initial attack response. The extended attack continues until either the transition to a higher level IMT is completed or the fire has been contained or controlled.

Planning and preparation for suppression actions within Yellowstone have been formulated with the goal of establishing a fire management organization that can, with park staff, control 90 percent of all fires that start in the park. Control of the remaining 10 percent of fire occurrences may require assistance from the nearest available adjacent cooperating agencies and regional or national resources. If a fire exceeds or threatens to exceed park capabilities, additional resources will be ordered through normal dispatch procedures. The amount and type of assistance needed and requested will depend on the present and expected complexity of the fire situation.

b. Implementation Plan Requirements: WFSA Development

The WFSA will be completed by the FMO with assistance from the Fire Management Committee when a human- caused fire escapes initial attack or where the AMR for WFU or prescribed fire has not been successful. Enhanced resource benefits may be a side benefit of the planned action under the WFSA but cannot be part of the objective of the action. Procedures and forms for the WFSA process are outlined in the *Implementation Guide*. A long- term implementation plan may be developed and appended to the approved WFSA.

As stated in the *Red Book*, Chapter 10, page 10- 16, the Superintendent has signature authority for WFSA costs below $2,000,000.00, the Regional Director has signature authority for WFSA costs from $2,000,000.00 up to $5,000,000.00, and the National Director has signature authority for WFSA costs above $5,000,000.00.

c. Complexity Decision Process: Incident Management Team Transition

The FMO will complete the *Incident Complexity Assessment* chart, Appendices 10- 4 and 10- 5, found in the *Red Book*, to determine the appropriate level of management of a wildland fire that has escaped initial attack. A WFSA will be completed and the necessary resources, including IMTs, will be ordered through normal dispatching channels.

Based on the completion of the complexity form, the appropriate level of management will be determined and the necessary resources will be ordered

through the normal dispatching channels. The local unit team or current IC will remain in place until the local unit representative briefs the incoming team, a Delegation of Authority has been signed, and a mutually agreed time for transfer of command has been established.

d. Unit example of "Delegation of Authority" for Incident Commander

When an IMT is assigned, the team will be briefed by the Superintendent and current IC. The team will be given a written Delegation of Authority (Appendix Q) and will have a Superintendent or designated Acting assigned as a staff member to the incoming IC. The Delegation of Authority will provide the IC with the Superintendent's priorities, specific restraints, and other guidelines necessary to carry out the WFSA. When the team has accomplished its assigned tasks, the fire will be transferred back to the park. A local IC will then be assigned, and a debriefing will be held by the departing team to provide for an orderly transition of command. The Superintendent will then conduct a closeout session that will include a performance evaluation of the departing team. The transition IC will then assume command following a thorough briefing and at the agreed- upon time and the departing team will be demobilized.

6. Exceeding Existing WFIP: Selecting a New Strategy

When wildland fires cannot be controlled during the initial suppression action or when the AMR in a WFU area has not been successful, the WFIP is considered to have been exceeded and a WFSA is initiated. Initiation of the WFSA is also necessary when implementation of a prescribed fire plan is not successful and the fire must be suppressed. The following situations that could require selection of a new strategy through the WFSA include, but are not limited to:

- Unacceptable risk to firefighter and public safety, natural or cultural resources, improvements;
- Fire leaving or threatening to leave the park boundary;
- Fire exceeds prescribed fire plan;
- Increasing demand on local and/or national fire management situation; or
- Superintendent directive.

The Fire Management Committee will update part 1 of the WFSA and make a recommendation to the Superintendent who will revalidate the status of active wildland fires on a daily basis. The FMO is responsible for completing and filing the report with all other information regarding that particular fire.

7. Minimum Impact Fire Suppression

Fire management activities within the park will be carried out in a manner that minimizes impacts to Yellowstone's natural and cultural resources. Minimum impact suppression tactics (MIST) (Appendix R) will be used and incorporated into the Superintendent's Briefing and Delegation of Authority to the incoming IMTs. The Resource Advisor will be responsible for evaluating MIST tactics. Suppression teams will use the methods and equipment commensurate with suppression needs and the chosen strategy of confine, contain, or control or a combination of these which will least impact park resources.

8. Short- and Long-term Rehabilitation Guidelines and Procedures

Rehabilitation will only be required where the impacts of the fire itself or the associated suppression actions are significant and can be mitigated. No rehabilitative action will be taken which will cause further damage to the environment. If the MIST actions outlined above are used, then only minimal rehabilitation will be necessary. Proper location of firelines will avoid the need for felling and bucking of trees as will the use of wetlines. When no human life or property is threatened, it is acceptable to use natural barriers for firelines even if more acres will be burned. Efforts to rehabilitate the direct impacts of fire suppression activities will begin as soon as possible, at times even before the fire is declared out. This will allow the park to utilize assigned resources and potentially reduce rehabilitation costs.

To minimize the introduction of exotic vegetation into Yellowstone, burned areas will not be reseeded. Residual seed and sprouting from the surviving below- ground plant parts will provide natural revegetation. When fire rehabilitation cannot be completed with existing wildland fire resources, a Burned Area Emergency Rehabilitation (BAER) plan will be developed. Since BAER projects can have a major impact on many aspects of park management, a coordinated interdisciplinary effort among Yellowstone natural and cultural resource managers, fire managers, resource managers, and visitor services staff will be required. BAER is an extension of emergency actions directly related to managing an unplanned wildland fire. The BAER plan will follow the guidelines as outlined in DO- 18, Chapter 12. BAER plans and funding requests will be submitted to the NPS Intermountain Regional Office (IMRO) within five (5) calendar days following control of a wildland fire that requires emergency rehabilitation. The BAER plan will follow the standard format as outlined in the DOI BAER Handbook and will identify the cost of initial damage assessments and mitigation actions, and estimate the scope of follow- up phases of work expected to result from initial assessments.

9. Completion and Tracking of Records and Reports

Early fire records since the establishment of the park were incorporated into the annual Superintendent's report in narrative form. All yearly records through 1969,

including fire occurrence, fire weather, fire equipment inventories, fire photographs, fire and lookout logbooks, and fire map atlases are currently stored in the museum archives. The records for the years 1970- 2004 are stored in the Fire Management Office and are under the responsibility of the FMO. During the fire season, daily fire situation reports are submitted by 1000 hours, to the NPS Fire Management Office in Boise, Idaho, and to the Northern Rockies Coordination Center in Missoula, Montana.

Fire weather information is relayed to the Fire Management Office on a daily basis during the fire season where it is entered into the WIMS by 1400 hours each day and is automatically archived into the National Fire Weather Data Library. This information is used to generate the NFDRS outputs which are calculated each day at 1600 hours to determine the staffing class for that evening and the next day and to evaluate the potential fire danger in Yellowstone. Fire weather forecasts are retrieved twice daily, once at 0800 hours and again at 1600 hours, and used in conjunction with the NFDRS outputs for pre- positioning resources and evaluating expected fire danger. The FMO is responsible for the use and storage of these reports.

Each wildland fire assist response to the interagency community will be assigned a fire number. This action requires the preparation of an Individual Fire Report (DI- 1202). These reports are submitted in writing by the FMO to the Chief Ranger for approval and are then entered into the NPS Fire Management Computer System for permanent archival. The FMO is responsible for the entry and accuracy of these reports.

The FMO is responsible for preparation of annual reports detailing fire and aviation activity. This report will be submitted to the Chief Ranger for final approval. A copy will remain on file in the Fire Management Office.

D. Wildland Fire Use

Since 1992, 158 fires totaling 12,795 acres have been managed as WFU fires. Yellowstone anticipates that the average number of fires managed as WFU fires over the next 10- 15 years will remain the same or increase slightly.

1. Objectives of Wildland Fire Use and Relationship with Resource Management Objectives

The objective of Yellowstone's WFU program is to allow all naturally- ignited wildland fires to burn unhindered where possible under the guidance of a WFIP. Where interagency cooperative agreements are in force, fires may be allowed to burn across management boundaries as long as they remain mutually acceptable to all parties and is managed under a joint WFIP.

All wildland fires will be evaluated by the criteria in the WFIP. Those fires recommended for management as a WFU fire by the Fire Management Committee and approved by the Superintendent will be managed according to the actions outlined in the WFIP. Qualified fire monitors will be assigned to each active WFU fire to provide accurate fire weather, fire behavior, and fuels information. Active status is defined as a burning period in which fire perimeter growth is expected to increase by 10 percent or 10 acres, whichever is less.

Public information is a vital component of the WFU program. The Public Affairs Officer (PAO) will play an important role in disseminating accurate and timely fire updates to the public via the various news media.

Wildland fires that do not meet the criteria to be managed as a WFU as described in the WFIP will be declared wildfires, and will be suppressed under the appropriate suppression strategy. Once a fire is declared a wildfire, it will never be reclassified as WFU.

2. Criteria Used to Make Management Decisions

Criteria for designating and evaluating natural fire starts are derived from a detailed analysis of daily fire weather, fire danger indices, and actual fire perimeter growth under specific fire behavior and weather conditions compiled since the start of natural fire management in Yellowstone in 1972. Key indicators used include overwinter precipitation and snowpack, spring rainfall, and 1000- hour fuel moistures that are correlated to historical ERC graphs for each FMU. The intent of these evaluations is to allow fire to play its ecological role in the park to the greatest extent possible. Wildland fire use fires will be allowed to continue burning if the weather, fire danger indices, projected fire behavior, and MMA will not be exceeded.

Initially, when a lighting- caused wildland fire starts, the Stage I analysis of the WFIP will be completed to determine if that fire meets the requirements for consideration as a WFU as outlined in the Stage I process. Upon completion of the Stage I analysis, the Superintendent will review the information with the Fire Use Manager (FUMA) and must sign the Decision Criteria Checklist, through a written Delegation of Authority to a senior park staff member or FUMA. This process documents the decision to manage a fire as a WFU.

Lightning- caused fires that meet these conditions will be declared WFUs. Lightning- caused fires that exceed these conditions will be declared wildfires and the appropriate suppression actions will be taken. When fire conditions or complexity levels escalate, revalidation authority will automatically and immediately revert to the Superintendent.

In the event of an escaped WFU, the Superintendent will determine the necessity of ordering of an IMT based on advice from the FMO using the Complexity Analysis in

the *Red Book*, Chapter 10, pages 26- 29. Any IMT order will be approved by the Superintendent prior to being placed through normal dispatch channels.

3. Pre-Planned Wildland Fire Use Implementation Procedures

The ignition of each new fire will be determined and its exact location plotted. All human- caused fires will be declared wildfires and immediately suppressed. All naturally- caused (i.e., lightning- caused) wildland fires will be considered as potential WFU candidates and a Stage I analysis will be completed within eight hours.

All fires initially approved as WFU will be assigned to a FUMA for the duration of the fire. The FUMA will initiate the monitoring and information gathering process to complete the Stage II analysis of the WFIP within 24 hours.

Monitoring of each WFU will continue on a daily basis. This will include daily revalidation that the WFU fire will continue to burn within the criteria described in the WFIP through completion of a revalidation form signed by the Superintendent or designated representative.

4. Non Pre-Planned Wildland Fire Use Implementation Procedures

a. Procedures for Periodic Assessment of Wildland Fire Use Applications

Monitoring of each WFU will continue on a daily basis either by on- site fire monitors gathering fire behavior and weather information, by daily reports from the closest fire lookout, or by an aerial detection flights specifically conducted to complete the daily monitoring update. The daily monitoring information will be compared to the applicable Stage I implementation actions to determine if the current actions are adequate or if additional actions are needed to manage the fire as a WFU. If a Stage III analysis has been completed, the fire behavior and weather calculations will be revisited each day to determine if the fire will remain within the approved MMA.

b. Outlines and Requirements for the Preparation of Wildland Fire Use Implementation Plans and Documentation

Information required to complete the WFIP include the following:

- Location of fire incident
- Fuel type, fuel model and GIS fire history maps
- Fire weather forecasts, short and long- range
- Fuel moisture content of most recent fuel surveys with emphasis on 1000- hour FMC
- Fire behavior predictions including pre- season FARSITE and RERAP calculations

- Risk analysis as outlined in the WFIP process
- Desired implementation actions based on resource and wilderness concerns
- Development of MMA

5. Potential Impacts of the Wildland Fire Use Implementation Plan

The *2000 GYCC Guide* provides authority, guidance and direction on WFU fire activity in the GYA. This guide was in part developed from the interagency fire review following the 1988 fire season. It was determined that guidelines should be developed to deal with large fires that had the potential to cross administrative boundaries and to take advantage of natural fire starts that could burn without suppression actions and accomplish fuels reduction benefits. Policies and guidelines were developed to address public safety by issuing coordinated fire information press releases, monitoring smoke emission levels, and issuing coordinated fire restrictions based on fire danger and drought. Lessons learned from the 1988 fire season include the following:

- Place firefighter and public safety as the first priority in every fire management activity.
- Coordinate unit fire management plans that manage wildland fires through joint planning efforts to allow wildland fire to act as an essential ecological process and natural change agent.
- Develop fire management plans and activities that incorporate public health and environmental quality considerations.
- Develop sound risk management processes as a foundation for all fire management activities.

The respective Agency Administrators have acknowledged by signing the document to allow WFUs to cross administrative boundaries that potential impacts both positive and negative are acceptable when joint preparation of the WFIP is conducted. Potential outcomes include:

- Perpetuation of natural processes in USFS wilderness areas and NPS backcountry areas managed as wilderness.
- Reduction of accumulation of unnatural fuel loading due to past fire suppression activities.
- Improvement of interagency cooperation on complex fire management activities.
- Improvement of fire management experience in managing complex WFUs.

6. Required Staff Positions for Wildland Fire Use Program

The FMO will be responsible for maintaining current records of all qualified red- carded personnel in the park. These records will be used for dispatch purposes to assign qualified and physically fit personnel to positions on a fire. These records will be updated after each fire season. Only a qualified FUMA will be assigned to manage a WFU fire.

To successfully manage the WFU program, the following positions will be maintained within the park.

- Fully qualified FUMA, either FUMA1 or FUMA2, as required by complexity analysis
- Fully qualified Fire Effects Monitors (FEMO) – 4 minimum
- Fire effects specialists with knowledge of establishing vegetative plots
- Fully qualified helicopter managers to transport personnel to remote WFUs
- Fully qualified fire dispatch personnel
- Experienced fire lookouts
- Fully qualified ICs
- IMT5 (minimum of two)
- IMT4s (two)
- IMT3 (one)

Additional park employees that are not full- time fire management staff will be trained in these positions to provide additional support so that multiple WFUs can be managed appropriately at one time. If additional WFUs are approved, qualified personnel will be ordered to manage these fires through the normal dispatch channels. The *2000 GYCC Guide* provides the authority for all units in the GYA to support WFU activity by sharing of qualified staff members.

7. Public Information and Interpretation of Wildland Fire Use

Yellowstone public information and interpretation staff are well- qualified to provide daily fire information updates through normal channels and to interpret extensive fire activity to the park's visiting public. Yellowstone has qualified Fire Information Officers on staff and has trained Interpretation Supervisors at each Park Visitor Center and developed area to assist the Fire Management Operation on an as- needed basis during periods of high fire activity.

Wildland fire use has been a fire management option in the park since 1972 and Yellowstone has gained extensive experience in managing multiple, large, complex suppression as well as WFUs during any given fire season. Yellowstone has standing agreements to request additional qualified personnel in the GYA, Region 1, the NPS IMRO and NPS fire management staff at- large to assist in various fire positions as the fire activity warrants.

8. Standard Outline of Contents for Permanent Project Record for Wildland Fire Use Application

The following documents and reports will be included as part of the permanent project record for WFU application.

Planning Documents
- WFIP
- WFSA
- FMP

Monitoring Reports
- Fire behavior and daily fire growth maps
- Fire weather data
- Fire effects plot data
- Photo documentation is archived on fire management data base

Revalidation documents
- Information found in WFIP for each WFU and daily revalidation process

Project Maps
- GIS maps are developed for each WFU
- GIS maintains a fire history map of each wildland fire greater than 100 acres

Fiscal Accounting
- Fire codes are used to generate a unique fire account number for each WFU
- Fire budget analyst compiles all costs associated with each WFU as part of the final fire packet

E. Prescribed Fire

1. Planning and Documentation

a. Annual Activities to Prepare and Implement Prescribed Fire Program

Prescribed fires may be used to achieve the resource management objectives outlined in the 1992 FMP and the 2004 Update. The annual prescribed fire program will be prepared by the FMO with assistance from the Prescribed Fire Specialist and Assistant FMO. The program will detail all prescribed fires planned for the year and specify objectives to be accomplished. The Chief Ranger and Fire Management Committee will review and submit this program plan to the Superintendent for approval. The program plan will then be submitted to the NPS IMRO for approval.

Actions included in the prescribed fire program include the park's selection and prioritization of prescribed fires to be carried out during the year, plans, prescriptions, operations, documentation and reporting, and burn critiques. Measures to ensure successful implementation of prescribed fires will include:

- All prescribed fire plans will be prepared, reviewed, and recommended by a burn boss qualified at or above the complexity level of the project;

- All prescribed fires will be conducted by a burn boss qualified at or above the complexity level of the project along with qualified support personnel to ensure a successful burn;
- An adequate number of holding crew personnel on hand to monitor, chase hot spots, mop- up, and serve as the initial attack crew in case of the fire's escape; and
- All prescribed fire plans will be approved and signed by the Superintendent.

The park reserves the option to utilize an interagency team approach for complex prescribed fires carried out in the boundary areas of the park or for proposed fires of large acreages. The most highly qualified and experienced personnel in the regional interagency community would be requested to serve on this team and the proposed prescribed fire plan would be peer reviewed.

b. Long-term Prescribed Fire Strategy for Fire Management Units

As stated in Section III, D, on pages 16 and 17, Yellowstone proposes to use prescribed fire to reduce heavy fuel loads in the critical boundary area of the Northeast Entrance in the Northern Range FMU. This area includes the historic Northeast Entrance stations and surrounding park housing structures, and is adjacent to the Gallatin National Forest and the gateway communities of Silver Gate and Cooke City, Montana. The park proposes to treat approximately 900 acres in two phases within the next 10 years, provided sufficient funding is secured and compliance is completed.

The FMO will recommend a burn boss for each prescribed fire. The burn boss will conduct a field reconnaissance of the proposed prescribed fire location with members of the Fire Strategy Working Group, Fire Management Committee and resource management staff to discuss objectives and special concerns and gather all necessary information to write the prescribed fire plan. After completing the reconnaissance, the burn boss and fire management staff will write the prescribed fire plan.

All written prescribed fire plans will be approved by the Superintendent and all prescribed fires will be conducted only under the clearly specified prescription parameters detailed in the prescribed fire plan. Prescribed fires may be conducted anytime during the year, depending upon when the area to be burned comes into prescription. The preferred time for prescribed fires would be during times of low visitation.

c. Required Personnel for the Prescribed Fire Program

The FMO will designate a qualified burn boss and other necessary prescribed fire team members to conduct the prescribed fire. Yellowstone will strive to maintain the qualified personnel necessary to conduct all prescribed fires activity in the park. This will be accomplished through training, prescribed fire experience, and recruitment.

The burn boss will fill all required positions necessary to conduct the prescribed fire with personnel qualified at or above the complexity level of the project including the Firing Boss, Holding Boss, and Ignition Boss. All personnel listed in the prescribed fire plan must be available for the duration of the prescribed fire or the prescribed fire cannot be carried out.

Yellowstone will require the following personnel to maintain and meet the complexity requirements of the prescribed fire program:

- one (1) RXB1
- one (1) RXB2
- two (2) Ignition Bosses
- two (2) Holding Bosses
- two (2) Firing Bosses
- one (1) ICT3

d. Weather, Fire Behavior and Fire Effects Monitoring

Weather and fuel moisture conditions must be monitored closely in planned prescribed fire units to determine when the prescription criteria are met. A weather station will be set up in the prescribed fire unit and equipped with a hygrothermograph, maximum and minimum thermometers, fan psychrometer, 10-hour fuel moisture sticks, and a precipitation gauge. Weather data will be gathered at least 30 days prior to conducting the prescribed fire so that accurate calculations of the 100- and 1000- hour timelag fuel moistures, energy release component, ignition component, spread component, and burning index (BI) can be obtained. Fuel moisture samples of 10- , 100- , and 1000- hour down and dead logs and of live plants will be collected each week, weighed, oven dried, and percent moisture contents calculated to help determine when the prescription criteria are met.

When all prescription criteria are within the acceptable range, the burn boss will select an ignition date based on current and predicted weather forecasts. All personnel and equipment will be assembled one day prior to the planned ignition date. A thorough briefing will be given by the burn boss, and specific assignments and placement of personnel will be discussed. A current spot weather forecast will be obtained on the day of ignition, and all prescription elements will be rechecked to determine if all elements are still within the approved ranges. If all prescription elements are met, a test fire will be ignited to determine on- site fire behavior conditions as affected by current weather. If conditions are not satisfactory, the test fire will be suppressed and the prescribed fire will be rescheduled. If conditions are satisfactory the prescribed fire will continue as planned.

e. Format for Critiques of Prescribed Fire Projects

The Fire Management Committee headed by the Chief Ranger will critique each prescribed fire project implemented in a report along with recommendations or changes deemed necessary for the prescribed fire program. This report will be submitted to the Superintendent and Regional Fire Management Officer for review. A post- season critique of the fire management program, including the prescribed fire program, will be held each year by the Fire Management Committee.

f. Reporting and Documentation Requirements for Accomplishments and Escaped Fires

All prescribed fire forms will be completed as outlined by the Burn Boss. A fire monitoring team will be assigned to collect all predetermined information and complete all necessary forms prior to, during, and after the prescribed fire. All records will be archived in the park's fire records and stored in the Fire Management Office for future use and reference.

The Burn Boss will prepare a final report on the prescribed fire for the Chief Ranger. Information will include a narrative of the prescribed fire operation, a determination as to whether or not the objectives were met, weather and fire behavior data, a map of the prescribed fire area, photographs of the prescribed fire, number of hours worked, and final cost.

g. Description of Local Prescribed Fire Plan Requirements

The prescribed fire plan is a site specific action plan which describes the purpose, objectives, prescription, and operational procedures needed to prepare and safely conduct the prescribed fire. The treatment area, objectives, constraints, and alternatives will be clearly outlined, and no prescribed fire will be ignited unless all prescriptions of the plan are met. The factors to include in preparing a prescribed fire plan are contained in RM- 18, Chapter 10, pages 1- 53. A completed prescribed fire plan is found in RM- 18 on pages 54- 97. RM- 18, Chapter 10, is under revision at this time; however the required elements are unlikely to be relaxed in the next version of NPS policy.

h. Exceeding Existing Prescribed Fire Plan

The FMO will designate a qualified ICT3 who will remain in close contact with the burn boss in the event of an escaped prescribed fire. If the prescribed fire escapes the predetermined prescribed fire area, all further ignitions will be halted and suppression efforts, as discussed in the pre- prescribed fire briefing, will be initiated. The assigned IMT3 will assume command of the incident and will account for, brief, and assign all personnel their specific suppression duties. The IMT3 will update fire dispatch and order any additional resources necessary to quickly suppress the escape.

The FMO will be notified, and if not already onsite, will proceed to the escape location and will be briefed by the IMT3. An incident complexity analysis will be completed to determine the appropriate level of management needed for the escape. The FMO may assign a more qualified IC if the fire behavior conditions warrant.

The Chief Ranger and FMO will be notified immediately by the burn boss of any control actions on a prescribed fire. The Chief Ranger will notify the Superintendent of the current situation and the PAO who will prepare a press release. If the prescribed fire exceeds the initial suppression efforts, the prescribed fire will be declared a wildfire and completely suppressed. A WFSA will be completed and additional personnel and resources ordered as determined by the ICT3.

2. Air Quality and Smoke Management

a. Air Quality Issues

The NPS fire management activities which result in the discharge of air pollutants (e.g., smoke, carbon monoxide, and other pollutants from fires) are subject to, and must comply with, all applicable federal, state, interstate, and local air pollution control requirements, as specified by Section 118 of the Clean Air Act, as amended (42 USC 7418). (See Section III, D, c, (3) on pages 29- 31 for more details on air quality issues.)

b. Program of Action to Manage Smoke

Yellowstone is designated as a Class I Airshed under the Clean Air Act and is required to protect air quality values, including visibility. A Class I Airshed is the classification that protects air quality in international parks, national parks greater than 6,000 acres, and federal wilderness areas greater than 5,000 acres that existed on August 7, 1977.

The Clean Air Act requires the EPA and individual states to develop long- term strategies to achieve national visibility goals for Class I areas. Yellowstone is bound by this legal obligation to protect air quality and related values in the park from potential adverse effects. All prescribed fires will be approved and permitted as required by the Wyoming Department of Environmental Quality, Air Quality Division (Chapter 10 of the Wyoming Air Quality Standards and Regulations (http://deq.state.wy.us/aqd/standards.asp). Yellowstone ensures compliance with the smoke management requirements of Idaho and Montana through a designated NPS regional representative with the Idaho/Montana Airshed Group and follows all state management operating laws. The most recent operating guide is the *March 2004 Montana/Idaho Airshed Group Operating Guide* (http://www.fs.fed.us/r1/fire/nrcc/Smoke_web_pages/OpGuide.pdf).

Yellowstone monitors baseline visibility, particulates, Sox (sulfur oxides), nitrogen dioxide, total suspended particles, carbon monoxide, and ozone as well as meteorological conditions in the Lake and Mammoth developed areas. A transmisometer is located at Lake to monitor trends in visible air quality. A National Atmospheric Deposition Program site is located at the Tower Ranger Station.

The USFS, WAQD, and the BLM have developed the Simple Approach Smoke Estimation Model (SASEM) computer model to estimate the possibility of a prescribed fire exceeding air quality standards. Yellowstone will use this model to determine smoke impacts, amounts of smoke to be emitted, and potential locations that may be affected prior to igniting any fire.

Smoke generated by prescribed fires will be managed to minimize degradation of air quality and visibility. The park's guidelines for smoke management from a prescribed fire are:

- All prescribed fire plans will have clear objectives and will monitor impacts of smoke on the human and natural environments.
- Prescribed fires ignited in proximity to structures will only be ignited during periods of low visitation and if the prevailing winds will carry the smoke away from the structures.
- Current and predicted weather forecasts will be utilized along with test fires to determine smoke dispersal.
- Smoke dispersal will be visually monitored on a continuous basis at set intervals during the course of all prescribed fires. If air quality standards are exceeded or smoke creates a hazard or nuisance, especially in or near smoke sensitive areas, the prescribed fire will be extinguished.
- An Air Quality Monitoring Plan will be developed and implemented for prescribed fires that larger than 100 acres and expected to last for more than three days.
- When prescribed fires are conducted, notification will include the states of Wyoming, Montana, and Idaho; the USFS; local communities that may experience smoke; park staff; park concessioners; and park visitors.

F. Non-Fire Fuels Management Applications

The Yellowstone wildland fire management program strives to protect natural and cultural resources and park infrastructure while providing for the enjoyment and safety of the park visitors and staff. Many of the developed areas in Yellowstone are surrounded by mid- to late- successional lodgepole pine stands. In an unaltered system, these stands are prone to periodic stand- replacing wildland fires. It is not uncommon in the timber fuel types found in Yellowstone to have crown fire flame lengths exceeding 100 feet, with averages of 50 feet. However, to fight fire safely and effectively from the ground, flame length must be less than four feet. The hazardous fuels surrounding developed areas consist of live and dead burnable plant materials that foster or promote the ignition, spread or build- up of a wildland fire that can

threaten the safety of people, structures, power lines or other park infrastructure, roads, political boundaries, or occur over an unacceptably wide geographic area.

It is the goal of the park to reduce these fuel loads and maintain lodgepole forests in early to mid- successional stages that are less prone to wildland fire. Non- fire hazardous fuels management includes mechanical (and some manual) removal of understory vegetation and thinning of tree canopies adjacent to structures in the backcountry and within the wildland- urban interface (WUI) of developed areas to protect firefighter and public safety, valued developments, and cultural resources. Although prescribed fire is sometimes preferred to mechanical treatment alone because it allows more nutrients to remain in the system, using prescribed fire adjacent to most developed areas poses increased risk to public and firefighter safety and to valued structures unless the fuel load is first reduced mechanically.

The methods used for mechanical management of hazardous fuels depend on the surrounding fuel types, fuel loading amounts, crowning potential, predicted potential rates of spread, topography, visual aesthetics, impacts to wildlife, and cultural and historic values within or near the proposed treatment area. Methods used are based on the *2001 Yellowstone National Park Structure Protection and Firefighter Safety Hazard Fuels Management Guidelines* (Appendix E) as well as experience gained through implementation of recent hazardous fuel reduction projects from 2003- 2005. The equipment and associated activities may include the use of chainsaws, skidders, chippers, trailers, ATVs, horse- skidding, winches, helicopters, motor vehicles, debris pile stacking and burning, and establishment of temporary decking and trailer turn- around areas. In accordance with NPS 2001 Management Policies, the "minimum requirement" concept identified in D0- 41 will be used to determine the equipment used in Yellowstone's recommended wilderness areas.

The goal of mechanical fuel reduction is to reduce the crown bulk density of vegetative matter to 30- 40 grams per cubic meter. This reduction is intended to eliminate the vertical and horizontal continuity of the fuel arrangement through removal or reduction of surface and ground fuels, thus reducing the likelihood of spot fire ignition, fire intensity, and the rate of spread. The objectives generally are as follows:

- 0- 30 feet from structures: remove all hazardous ground and ladder fuels (seedlings, saplings, downfall, standing dead, and trees);
- 30- 120 feet from structures: remove all standing dead and 70- 80% of the ground and ladder fuels;
- 120- 400 feet from structures: remove 50% of ground and ladder fuels, with the amount of understory left increasing with distance from structure; and
- Mature trees from 30 feet to the treatment edge will be thinned to achieve an average 20- foot crown spacing (distance measured between driplines of the tree crowns).

The number of acres to be treated in reducing hazardous fuels depends on several environmental and socio- political factors that include, but is not limited to:

- The impact to aesthetics, cultural resources, and natural resources (including exotic vegetation and threatened and endangered species)
- The type, age, amount, diversity, volatility, and fire history of the vegetation around the area of concern
- General weather patterns such as wind directions and speed, lightning probability, length of fire season, etc.
- The construction, design, materials and value of the structures at risk
- Risk of human caused fire, human density, ease of evacuation, etc.
- The topography of the surrounding area

Each treatment site is analyzed according to the above criteria with an emphasis on conducting the reduction in a manner that is visually appealing and with the least impacts to park resources. However, there are no single fuel reduction standards that apply to all locations and all vegetation types.

Potential biomass utilization includes firewood sale, firewood use by park residents, and material for trail stabilization and buck and rail fence whenever feasible. Utilization may also include contractor- transported logs to the NPS Golden Spike National Historic Site near Brigham City, Utah, for use as fuel in their steam locomotives. When biomass material can not be efficiently or economically accessed for utilization, on- site disposal methods such as debris piling and burning, scattering, and chipping will be used. Stacked debris piles may need to remain on site for up to two years for curing prior to burning. For all pile burning activities, the park will comply with applicable requirements by the Wyoming Department of Environmental Quality, Air Quality Division (Chapter 10 of the Wyoming Air Quality Standards and Regulations (http://deq.state.wy.us/aqd/standards.asp) and the Idaho/Montana Airshed Group's March 2004 Operating Guide (http://www.fs.fed.us/r1/fire/nrcc/Smoke_web_pages/OpGuide.pdf).

Since the 1992 FMP, hazardous fuels reduction projects have been completed within the wildland- urban interface at East Entrance, Northeast Entrance, and Lake developed area in 2003 and at West Yellowstone Entrance, South Entrance and Canyon Village in 2004. Hazardous fuels reduction projects were completed for the Howell Creek, Crevice Creek, Winter Creek, Fox Creek, Buffalo Plateau, Harebell, and Heart Lake backcountry cabins from 2003- 2005.

An EA was completed in 2002 for compliance under NEPA for the WUI projects at East Entrance, Northeast Entrance, and Lake Developed Area and the backcountry cabins (USDI 2002*a*). Informal Section 7 consultation under the ESA with the FWS was also completed in 2002 for these same developed areas and all of the backcountry cabins (USDI 2002*b*).

Categorical exclusions under NEPA were completed for the West Yellowstone Entrance, South Entrance and Canyon Village WUI projects in 2004 based on June 2003 USDA/USDI guidelines that allow categorical exclusions for certain hazardous fuels reduction projects (33814 Federal Register Vol. 68, No. 108. / Thursday, June 5, 2003).

1. Annual Activities

The park has identified approximately 191 acres of hazardous fuels to be treated in nine remaining WUI areas and 218 acres at 25 backcountry cabins during the next 8-10 years. Appendix S lists these projects, the corresponding FMUs, numbers of acres to be treated, and compliance status. All are fire regime V and condition class I. These areas as well as the previous areas treated in 2003 and 2004 will be maintained in the treatment state over time. Compliance under NEPA was completed for the backcountry cabins in June 2002. NEPA compliance will be completed prior to implementation of each of the remaining eight proposed WUI projects (NEPA compliance was completed for the Bechler Ranger Station in 2002). Informal Section 7 consultation under the ESA was completed for the remaining backcountry cabins and the Bechler Ranger Station in May 2002 and for the eight proposed remaining WUI areas in February 2005. Section 106 consultation under the NHPA will be completed prior to implementation of each project.

Management priorities and methods are determined jointly by fire management personnel in consultation with appropriate park resource specialists through the Fire Strategy Working Group and the Fire Management Committee.

2. Equipment and Seasonal Use Restrictions

The opportunity for implementing WUI projects in Yellowstone is very short and primarily limited to the months of June- early October. This short season is further complicated by the timing of snowmelt which limits access to WUI areas for cultural and natural resource surveys to the summer; timing of the use of fire management equipment and staff for other fire management responses; and the approximately three million visitors to the park, who are concentrated in the developed areas during July and August. Therefore, it is preferable to schedule WUI operations in the fall. However, that leaves little time to implement multiple projects in one season or complete some of the larger WUI operations. In addition, WUI operations seek to avoid working in areas of wildlife habitat during denning periods in the spring or during the fall in areas of reproducing whitebark pine that grizzly bears need prior to hibernation.

3. Effects Monitoring Required

Hazardous fuels reduction seeks a balance between removing hazardous fuels to protect valued structures and preserving the aesthetics of the landscape, cultural resources, and natural resources. The fire effects crew samples overstory tree fuel

loading, understory density, and surface fuel loading. A crown bulk density analysis will be conducted on the treatment site before and after the WUI treatment and is a component of a final WUI report.

4. Format for Critiques of Mechanical Fuels Reduction Projects

Critiques for mechanical hazardous fuel reduction projects will be carried out by the WUI project manager in consultation with members of the Fire Strategy Working Group. The analysis will use the pre- and post monitoring protocols including the down and dead fuel loading and crown bulk density analysis. Fire management staff use photopoints to monitor changes in fuel loadings. WUI project information including the photoseries will be made available to all park personnel via park computer common drives to provide an opportunity to comment on the project.

5. Cost Accounting

Funding for the WUI program are requested via the approved NPS process in the National Fire Plan Operations and Reporting System (NFPORS). All fuel program funds are tracked by the fire budget analyst and entered into the NFPORS data base by the Prescribed Fire Specialist.

6. Reporting and Documentation Requirements

Impacts to park resources from each proposed WUI project in the future will by assessed by an interdisciplinary team and through needed field surveys. An Environmental Screening Form will be completed as part of the park's NEPA process to determine whether a Categorical Exclusion, Environmental Assessment or Environmental Impact Statement is applicable for each project. Consultation with the appropriate SHPO will be completed for compliance with Section 106 of the NHPA prior to implementation of each project. Informal Section 7 consultation under the ESA for effects to federally threatened species was completed in March 2002 for four developed areas and the backcountry cabins. An informal programmatic Section 7 consultation was completed in March 2005 for eight proposed WUI projects (Appendix J). An annual report of effects to threatened species is required as part of this programmatic consultation. Any WUI project in the future that was not evaluated under this Section 7 consultation may need to undergo a separate Section 7 consultation with the FWS if the park determines that a proposed project "may affect" a federally listed species.

Project completion reports are required to be entered into the NFPORS database. This process will document that the park's targeted acres for treatment have been met as well as accountability for the funds expended. The FMO will ensure the data is input into the NFPORS database and this action will complete the verification process for WUI projects.

G. Emergency Rehabilitation and Restoration

Procedures for post- fire emergency rehabilitation (stabilization), restoration planning and implementation are contained in the Interagency Burned Area Emergency Stabilization and Rehabilitation Handbook and RM- 18, Chapter 12.

V. ORGANIZATIONAL AND BUDGETARY PARAMETERS

A. Organizational Structure

1. Fire Management Committee

The Fire Management Committee (Committee) consists of the Chief Ranger, Assistant Chief Ranger, FMO, Assistant FMO, Research Representative, and the affected District Ranger. The Chief Ranger will chair the Committee. A Resource Advisor may be assigned to provide information and advice to the Fire Management Committee on managing natural and cultural resources during suppression, WFU fire, prescribed fire, and non- fire fuels management events. Technical expertise from other individuals may be requested by the Committee at any time. Each committee member will designate an alternate to serve in the event that he or she is unavailable. A quorum will consist of at least the Chief Ranger, FMO, and affected District Ranger or their designated alternate(s).

a. Committee Actions During Wildland Fire Use Fires

The Committee will evaluate all new fire starts. The Committee will be convened by the Chief Ranger immediately upon confirmation that a lightning- caused fire is burning. All human- caused fires will be immediately suppressed. The FMO will present fire information to the Committee through the WFIP Stage I. The Stage I information will aid the managers by providing them with decision criteria for the initial decision whether to continue management of the fire for resource benefits or to take suppression action. The Chief Ranger will present the Committee's recommendation to the Superintendent who will approve the decision to manage the fire for resource benefits or initiate a suppression- oriented AMR. Upon written approval from the Superintendent, the FMO will implement the approved course of action.

During any active WFU, the Chief Ranger, representing the Committee, will brief the Superintendent on the current fire situation as often as necessary, based on fire behavior activity and the criteria detailed in the WFIP. Alternatives and recommendations for any change in the management strategy of the fire will be presented to the Superintendent. The FUMA is responsible for the fire through a Delegation of Authority and coordinates daily with the FMO. The FUMA is responsible for validating and updating the WFIP daily in coordination with the FMO. The Superintendent is required to approve the WFIP based on the established Periodic Assessment schedule. If the WFU event is no longer meeting

resource benefits or the Superintendent has determined that all Decision Criteria are no longer valid, then the fire will be suppressed under the AMR.

b. Committee Actions During Suppression Activities

If a fire escapes initial attack, the Committee will ensure that a WFSA is prepared. The Committee will stay informed of the fire situation on a daily basis in order to brief the Superintendent and PAO as well as to provide guidance and support the fire management staff in carrying out all fire management actions.

c. Committee Actions During Non-Fire Periods

The Committee may be convened during periods of high fire danger to coordinate preparedness activities and formulate recommendations regarding travel restrictions, area closures and fire restrictions in the backcountry. A pre- and post-fire season meeting of the Committee will be convened to coordinate and critique the Committee's operation and function.

2. Fire Strategy Working Group

The Fire Strategy Working Group is an in- house interdisciplinary team comprised of wildland fire management, resource management, and planning specialists. This group meets periodically throughout the year to discuss compliance, resource surveys, and implementation requirements for non- fire hazardous fuel reduction and prescribed fire projects. Under the 2004 Update, this team will work with cultural and natural resource specialists to integrate survey information and protection requirements for sensitive resources (including federally listed species) within individual FMUs for the wildland fire management program. This team will meet annually prior to each fire season to review any updated resource information to consider during suppression activities, WFU, prescribed fire, and non- fire fuels reduction projects and will convey this information to the FMO and Fire Management Committee.

3. Roles and Responsibilities for Fire Management Program by Specific Park Positions

Appendix T lists the roles and responsibilities by specific park staff positions to provide clear direction and accountability for implementation of a responsive fire management program. Appendix U lists the fire management responsibility assignment for decisions and actions by park function.

B. FIREPRO Funding

NPS fire management funding includes both fixed funds from FIREPRO and a shared national fund for emergency wildland fires. FIREPRO is an automated fire management budget planning and programming system developed by NPS (see

Chapter 17 of RM- 18 for details). It is designed to quantify the *Most Efficient Level* financial support requirements for fire management activities at all organizational levels through common analyses of workload and program complexity. Fixed funds at the NPS level are managed for program operations and planned projects (authorized project funds). Park fire operations and projects include preparedness activities, permanent staffing, training, monitoring, fire GIS, fuels management, fire prevention and education, aviation and equipment purchases. In addition, FIREPRO identifies the minimum staffing and program support that will achieve program performance targets for wildland fire managed for resource benefits, non-fire hazardous fuels reduction and prescribed fire to allow the natural role of fire to achieve resource management objectives.

Actions taken under Staffing Classes 1- 3 are funded through the normal FIREPRO budget. Additional actions detailed under Staffing Classes 4- 5 can be supplemented by emergency funds requested through the Regional FMO.

FIREPRO is based on the following principles of fire program management:

1. Permanent and seasonal staffing should be based on the normal- year workload and the complexity of the fire program at all organization levels.
2. Workload and complexity should be measured by common standards applied to individual programs. Workload is measured by key indicators such as the number of wildland fires, length of fire season, the number of prescribed fires, and the annual acres burned or planned for prescribed fires. Program complexity is measured by key indicators such as resources at risk from wildland fire, the burning conditions under which most fires burn, fuel types, the probability of prescribed fire escape, the risk to resources from an escape, smoke impacts, and the difficulty of achieving desired fuel reduction objectives.
3. The normal fire year is an appropriate standard for measuring program workload and will be calculated separately from wildland fires managed for resource benefits and for suppressed wildland fires. The normal year for suppressed wildland fires is the year with the third highest number of wildland fires in the past ten years of record. The normal wildland fire managed for resource benefits year is the year with the third highest number of acres burned by wildland fire managed for resource benefits in the past ten years of record. Programming is based on the normal rather than the greatest workload year because it is not cost effective to staff "up front" for the worst case scenarios in fire management. Prescribed fire projects are the exception to the normal fire year logic. The NPS must be capable of fully staffing and funding all approved projects since these are planned events.
4. The most efficient program level should be based on an analysis of both wildland fire and prescribed fire workload and complexity. Hazardous fuels reduction is, in many cases, as important or more important than additional firefighting resources in reducing suppression costs and resource losses.
5. A 95 percent success target for initial attack represents the point of diminishing returns for preparedness staffing. Since some wildland fires will occur under

extreme conditions and others will occur in large clusters of up to 40 at one time, it is impractical to expect all initial attacks to be successful.
6. During above- normal years, parks can utilize resources from other parks and interagency resources.
7. Hazardous fuels reduction and ecosystem management prescribed fire projects lower the target levels for suppression preparedness resources and reduce overall program cost.
8. The NPS should be able to provide qualified incident overhead team personnel to meet the incident workload requirements of the past 5 years.
9. Aircraft and engine support requirements should be based on the number, accessibility, and burning characteristics of wildland fires.
10. FIREPRO analyses should be designed to identify baseline- staffing needs and funding support requirements, but the programming system should remain responsive to unusual needs that might fall outside the bounds of the baseline analyses. Since no model or analysis formula can accommodate the full range of baseline needs, management must be able to override the analysis in some cases.

National emergency funds are managed for wildland fire operations. Within the NPS portion of the Department of Interior (DOI) firefighting account, budgets could be insufficient to cover expenditures for suppression and rehabilitation during severe fire years. In these situations, the NPS would first request that DOI transfer wildland fire management funds from other bureaus or, if these funds were unavailable, use the emergency authority under Section 102 of the general provisions of the Interior Appropriations Act, to transfer funds from other programs. The NPS would then seek to restore funds to affected programs through a supplemental appropriation.

Funding for FIREPRO activities is provided through the DOI firefighting account (P.L. 101- 121, 1990 Department of the Interior and Agencies Appropriation Act), which may be supplemented by the emergency authority provisions of Section 102 of the DOI. FIREPRO funds are funds which are distributed to parks and regions by the Branch of Fire Management, acting through the NPS Washington Budget Office. The following FIREPRO- funded activities will be managed through the use of Project Work Elements:

- WFU monitoring and management projects
- Hazardous fuel reduction projects
- Prescribed fire
- Step- Up Staffing Plan actions (emergency preparedness)
- Wildfire suppression actions
- Emergency rehabilitation actions

Other fire management activities will be funded through Annual Operating Programs. Funds for emergency preparedness and wildfire suppression are designated for the Step- Up Staffing Plan and suppression actions and may not be used to manage WFU activities.

The FIREPRO budget process will be replaced by the Fire Program Analysis system starting with the FY2007 budget. This is an interagency planning process designed to increase economic efficiency through promoting more accurate allocations of shared resources and personnel. Although the interagency budget process is new, Yellowstone, Caribou- Targhee National Forest, and Gallatin National Forest have had shared positions and equipment for a number of years, which has led to an efficient and economic organization. These shared resources include aviation, suppression, fire use, fire effects, GIS, education/prevention, dispatch, fuels management, and overhead positions.

C. Relationship of Fire Management Organizational Structure to Yellowstone National Park Organizational Structure

See Appendix V.

D. Superintendent Delegation of Wildland Fire Use Responsibility to Another Organizational Level

Yellowstone's Superintendent is responsible for annual assessment and certification by signature that continued management of WFU actions is acceptable. The Superintendent may delegate this responsibility to another organizational level under certain conditions.

E. Interagency Cooperation

Eastside IMT Program
Yellowstone participates in the Eastside IMT Program by providing qualified wildland fire personnel to serve as overhead team members. The park's FMO is an interagency voting member on the oversight committee that annually revises the Eastside IMT Operating Plan and nominates and approves team members.

Northern Training Center
Yellowstone cooperates with the Northern Training Center administered by Region 1 of the USFS in Missoula, Montana, for the purpose of conducting interagency training in wildland fire. The park's FMO is a voting member on the training oversight committee that reviews the mission of the training center, proposes annual training courses, and determines which wildland fire courses will be offered on an annual basis.

Montana Indian Firefighter Program
Yellowstone cooperates with the Montana Indian Firefighter Program administered by the Bureau of Indian Affairs in Billings, Montana. The park's FMO is a member of the interagency oversight committee that annually reviews the program. Yellowstone also provides instructors for annual single resource boss- crew training offered through the program.

Northern Rockies Coordinating Group
The IMRO FMO represents the national park units in the Northern Rockies. The Northern Rockies Coordinating Group sets the direction and establishes guidelines for all matters concerning wildland fire in the Northern Rockies area. The NPS regional FMO represents all park units in the Northern Rockies.

Greater Yellowstone Area Interagency Fire Management Planning and Coordination Guide (2000 GYCC Guide)
Following the 1988 fires in the GYA, a Fire Management Policy Review Team issued a report examining federal fire policies. In response to this report, the GYCC addressed the recommendations of the team by developing this guide. The guide has three objectives: (1) strengthen fire management planning within the GYA; (2) develop specific operating principles and procedures to provide effective interagency coordination and management of prescribed fires and wildfires occurring in the GYA; and (3) clearly define the role of the GYCC in fire management within the GYA. This guide was revised in 1995 and 2000.

The team committee consists of the regional foresters of the Intermountain, Northern, and Rocky Mountain regions of the USFS; the Regional Director of the Rocky Mountain Region of the NPS; forest supervisors of the Beaverhead- Deer Lodge, Caribou- Targhee, Custer, Gallatin, Shoshone, and Bridger- Teton national forests; and Superintendents of Grand Teton and Yellowstone national parks. Yellowstone's Superintendent or Deputy Superintendent is the standing member of this group that provides wildland fire management oversight to the GYA FMOs. A member of this committee acts as a liaison to the GYA Fire Management Advisory Group on all wildland fire management issues.

F. Key Interagency Contacts by Function

The FMO coordinates the park's fire management program with other agencies by acting as the park's primary representative at interagency meetings and by communicating with these agencies during on- going fires. Appendix W contains a list of the key interagency contacts.

G. Rural Fire Assistance Program

The Rural Fire Assistance Program is designed to increase firefighter and public safety and enhance the wildland fire protection capabilities of rural fire departments through financial and other assistance from NPS. The NPS may provide technical assistance, training, supplies and materials, equipment; and participate in interagency prevention, educational activities, and proficiency exercises on a cost-share basis with rural fire departments. Direct purchase of engines and telecommunications equipment is excluded; only the Regional FMO may authorize limited exceptions.

Distribution of funds from NPS is based on applications from rural fire departments. Eligible departments must serve a community of 10,000 people or less and contain a wildland- urban interface area. Priority is given to rural fire departments that meet accepted standards of wildland fire qualifications, training, and performance; protect rural communities; play a substantial cooperative role in the protection of NPS lands; and support interagency fire efforts. The rural fire department must meet a cost share minimum of 10%. Cooperator contribution may be in the form of in- kind service, support costs, or dollars. Yellowstone supports the following rural fire departments through the following cooperative agreements:

- Park County, Montana Rural Fire District #1
- Gateway Hose Company: Gardiner, Montana Fire Department
- West Yellowstone, Montana Volunteer Fire Department
- Park County, Wyoming Rural Fire District #2

H. Fire-Related Agreements

The *2000 GYCC Guide* contains three interagency agreements:

(1) interagency agreement among the Beaverhead- Deerlodge, Bridge- Teton, Custer, Gallatin, Shoshone, and Caribou- Targhee national forests, Grand Teton National Park, and Yellowstone National Park, to coordinate planning and joint management of fire activities which cross multi- jurisdictional boundaries;
(2) between Yellowstone and the Gallatin National Forest to coordinate suppression of wildland fires in and around the towns of West Yellowstone, Gardiner, and Cooke City, Montana; and
(3) among the Beartooth Ranger District of the Custer National Forest, Gallatin National Forest and Yellowstone to coordinate zone dispatching activities and training through the Bozeman Interagency Coordination Center.

VI. MONITORING AND EVALUATION

A. Short- and Long-term Monitoring Protocols for Resource Management Objectives

Fire Monitoring Protocols in Yellowstone
Yellowstone established a fire effects monitoring crew in 1998. Installation and monitoring of standard fire effects monitoring plots occurred in 1999. To date, approximately 25 plots have been established in hazardous fuel reduction areas and proposed prescribed fire units, but most have been installed in areas likely to be ignited naturally. Of the latter set of plots, about one- half are burned by the fire, providing pre- and post- burn data. The majority of initial monitoring efforts were directed at the park's extensive lodpepole pine forests. However, the park now focuses attention on the less represented Douglas- fir forests in the northern, lower elevation areas of the park, and whitebark pine forests at high elevation. These plots

are used to relate fire behavior to vegetation and fuel loading, and to track long- term changes in the ecosystem as a result of fire.

Early Post- Fire Lodgepole Pine Custom Fuel Model and Photoseries
In 1988, Yellowstone experienced its most dramatic fire season. Some of these post-burn areas have experienced a reburn during the exceptional drought of the last few years, while other such areas did not reburn when the opportunity was presented. Given the sheer acreage of burned area in 1988, understanding the conditions necessary to again support sustained combustion in recently burned areas represents the greatest challenge to the YNP fire management program into the foreseeable future. Since 2000, the fire effects monitoring crew has collected fuel loading information and has completed a fuel assessment photoseries guide. The photoseries guide includes a custom fuel model which can be used by fire behavior analysts to aid in predicting rate of spread and fire intensity in recently burned areas.

Estimation of the Threshold Canopy Bulk Density to Sustain Crown Fire in Lodgepole Pine Forests
The propagation of crown fire through a forest canopy has been theoretically modeled. Crown fire models describe fire behavior based on a number of factors including canopy bulk density or the mass of foliage and fine woody fuels per volume of canopy space. The park has measured canopy bulk density in a stand of lodgepole pine that burned by crown fire in July 2003 to empirically verify crown fire modeling. The minimum measured canopy bulk density approaches the threshold canopy bulk density. The threshold canopy bulk density figure is useful to fire and land managers who wish to treat hazardous fuels in urban interface areas by providing a target level of canopy fuels.

Early Post- Fire Plant Community Successional Pathways
Plant community response to fire is dependent on fire severity and environmental gradients such as elevation, soil properties, slope, and aspect. To date, few studies have examined long- term trends in plant community composition with such a diverse sampling of plots. The park's dataset includes eleven post- fire vegetation plots distributed widely across the park. The plots were installed between 1977 and 1989 and have been resampled every few years. Information is collected on surface fuel loading, ground- layer vegetation, and tree populations. The field phase is on-going; the latest sampling was 2001. Preliminary findings indicate a wide variation in both pre- and post- fire forest vegetation composition and abundance. However, several years post- burn, the plant communities become very similar within soil type, dominated by a suite of characteristic post- fire opportunists. Over the next 100- 300 years, these communities are expected to remain divergent between soil types, yet similar within soil type, perhaps approaching their pre- fire composition once again.

Assessment of Fire Severity Using Satellite Imagery
Historically, fire severity and extent were mapped on topographic maps by ground crews or from aircraft. Both methods are costly and inefficient, providing simple line drawings with little detail. With the advent of satellite imagery fire perimeters

and severity may be mapped at the scale of 30x30 m (9688 sq ft') pixels. For example, a 1,000 ha (2,500 acre) fire is composed of over 14,000 individual picture elements in the satellite image, each representing some level of fire severity and providing an unprecedented level of information. In order for the satellite image to be meaningful the information that the satellite "sees" must be correlated with observed conditions on the ground (ground- truthing). The fire effects crew walks each eligible burn assessing fire severity information which is used to ground- truth the image. When completed, the images will be used to update the vegetation and fire history layers of the park's geographic information database and become usable to resource managers and researchers.

A Fire History Database for Yellowstone National Park 1931- 2004
Yellowstone has sporadic records of fires dating back to the 1880s. After 1930, records were consistently kept but differences in filing and storage over the years prevented their general use. Beginning in 2000, the Fire Management Office researched and collected all the information from the archives and created a systematic database consisting of narrative and spatial data. Fire perimeters were created in the park's geographic information database for fires > 40 ha (100 acres) (Appendix K). Smaller fires were mapped as points. All related information for each fire was transcribed into a searchable database.

B. Wildland Fire Monitoring Plan

All WFU fires and prescribed fires will be monitored by qualified personnel under standards identified in this plan. The Prescribed Fire Monitor will assign fire monitors. Fires will be monitored either on- site, by the three fire lookouts, by aerial overflights, or a combination of these resources.

The level of monitoring will be determined by the current and predicted fire behavior activity. Active WFU fires will have a fire monitoring team assigned. The lead person on this team will be qualified at the IC4 and Fire Effects Monitor (FEMO) level. When fires are active, on- site fire monitors will take fire weather variables on an hourly basis, estimate fire behavior parameters, note fire effects, conduct down and dead fuel inventories, collect vegetative samples (both dead and live) for fuel moisture content percentages, and take photographs of the fuel type and fire behavior. Wildland fire use fires that are inactive or in size class A (0 - 1/10 acre in size) and are predicted to remain in this size class, may be monitored by a lookout or aircraft overflight.

Yellowstone is developing a field monitoring guide to allow the Fire Management Committee to stay apprised of the fire situation at all times and update its evaluation of the fire each day to ensure protection of human life and property both inside and outside of the park. The specific objectives of monitoring are:

- To gather daily fire weather, behavior, and growth information for update of the WFIP.

- To determine if the fire is burning within acceptable conditions or is predicted to exceed such conditions.
- To provide information that will ensure protection of human life, property, and cultural resources.

Yellowstone has compiled and analyzed long- term drought conditions by utilizing 1000- hour fuel moisture contents. The 1000- hour fuel moisture data is obtained by collecting down and dead logs, three to eight inches in diameter, at predetermined locations in Yellowstone. These logs are weighed and then oven- dried to determine the exact fuel moisture content (in percent). This data is then correlated against the 1000- hour moisture content generated by the fire weather observation inputs into the NFDRS (Renkin and Despain 1992). Active fire behavior is generally not observed until 1000- hour fuel moisture indices drop below 18%. During such fuel moisture levels, fire behavior and resulting areas burned is minimal. When fuel moistures decline further to 13%, an apparent threshold level of moisture is achieved because lightning strikes quickly result in observable smoke columns and, if fuel conditions are optimal, quickly exhibit fire spread.

During 1000- hour fuel moisture periods between 14- 12%, fire behavior is constrained by forest type. The old- growth, mixed canopy LP3 and climax spruce-fir (SF) forest types readily burn, but the successional lodgepole pine (LP0, LP1, LP2), multi- aged climax lodgepole pine (LP), Douglas fir (DF), and whitebark pine (WB) forest types do not. Strong winds, however, are able to buffer or perhaps supersede this fuel moisture- forest type influence for short durations. These fuel moisture- forest type influences begin to break down when 1000- hour fuel moistures drop below 12%, where increasingly younger and more varied forest types begin to burn readily, especially when influenced by high winds. Prolonged period of 1000- hour fuel moisture indices below 12% were observed in both the 1981 and 1988 fire seasons.

Yellowstone also monitors the daily ERC and correlates these values with the 1000-hour fuel moisture data. During winter months, snowpack data is analyzed on a monthly basis through the Snotel website and snow course data gathered in the park. Yellowstone also monitors the Palmer Drought Index monthly maps produced by the Boise Fire Weather Office and the Keetch- Byram Drought Index. These two indexes will be carefully monitored to provide park staff with additional information on evaluating drought conditions.

VII. FIRE RESEARCH

A. Previous and Ongoing Fire Research in Yellowstone

Research on the park's fire history has evaluated the natural role of fire in the Yellowstone ecosystem and is a necessary component of the fire management program. This research was the foundation for the WFU program begun in 1972. Wildland fire research is conducted by, or is under the permitting of, the

Yellowstone Center for Resources Division at Yellowstone. Research on fire occurrence and behavior continues, as with fire effects research on vegetation, wildlife, fisheries, water quality, air quality, soils, and plant succession. Research projects undertaken in the aftermath of the 1988 fires provided valuable information about the effects of such large magnitude fires (Franke 2000).

B. Fire Research Related to Cultural and Natural Resource Management Objectives

Past and current projects have established research methods and techniques to determine short- and long- term fire effects in Yellowstone. Fire effects research has been conducted and is continuing in the following areas: wildlife, fisheries, vegetation, fuel moisture sampling, soils, landscape patterns, water quality, and air quality. Copies of fire effect publications and information on fire effect projects may be obtained from the Yellowstone Center for Resources Division.

VIII. PUBLIC SAFETY

A. Public Safety Issues and Concerns

Yellowstone's fire management program is dedicated to ensuring the safety of firefighters, visitors, and residents as well as private property adjacent to the park's boundary. The Superintendent may close all of the park or a portion of it (including roads and trails) when either wildfire or a WFU fire poses an imminent threat to public safety. The park will inform visitors of all fire activity on a daily basis through normal communication channels. A fire activity report will be updated daily, or when significant changes warrant, to inform park personnel of any potential threat. Areas of fire activity will be clearly signed at trailheads and along roadways. Backcountry personnel will inform visitors obtaining permits for backcountry use of the exact location of fire activity. Residents in gateway communities adjacent to the park will be immediately notified by law enforcement personnel of any fire which poses the threat of burning outside the park's boundaries.

Extreme wildland fire events forced the closure of park entrance stations in 1988, 2001 and 2003. Full park evacuations occurred during the 1988 fire season. Yellowstone's Superintendent will make the final decision to order park closures or evacuations based on recommendations from the Chief Ranger on the Fire Management Committee. Appendix X contains the procedures for making park closure and evacuation decisions.

B. Procedures for Mitigating Safety Issues and Concerns

In addition to the mitigation notification system listed above in *A. Public Safety Issues and Concerns*, the following procedures for mitigating safety issues and concerns will be implemented:

- The FMO will coordinate all actions with the affected District Ranger(s) and Sub-District Ranger(s) while under the direction of the Chief Ranger.
- The normal chain- of- command structure for all emergencies will be followed, keeping the Superintendent and PAO informed throughout the duration of the issue or item of concern.
- All mitigation actions will be transmitted via the park radio communication system.
- The park's interagency cooperators will be notified on an as- needed basis, depending on the safety concern and how widespread the issue.
- Law Enforcement and Structural Fire Departments will assist on as- needed bases.
- Additional resources will be ordered through normal dispatch channels.

IX. PUBLIC INFORMATION AND EDUCATION

A. Public Information Capabilities and Needs to Implement Plan

Dissemination of information concerning fire activity will be the responsibility of the FMO through the PAO. The PAO will contact the news media and provide pertinent information. This information will be made available to all entrance stations, campground offices, the visitor service office, visitor centers, and park personnel through normal communication channels. Notification of cooperators will be accomplished through the Fire Management Office.

B. Education

Efforts to educate the public about the fire management policy will be handled at the national level through normal channels and through Yellowstone's Interpretation Division at the park level. The Interpretive staff will continue their efforts in informing the public about NPS and Yellowstone philosophy of fire, and the role of fire in Yellowstone's ecosystem. This may include having on- site interpretive personnel at a fire to answer specific questions or leading groups of visitors to a vantage point from which to watch a fire. Slide presentations, video tape presentations, and interpretive talks will address the fire management program and explain the role of fire in the Yellowstone ecosystem. The fire management staff will provide the following information, in a timely manner, about all fire activity to the PAO and Interpretation offices for dissemination:

- Fire location, behavior, and growth
- Fire management actions being taken on the fire
- Commitment of park personnel and equipment, including commitment of park resources, to any fire burning outside of the park
- Restrictions and closures within the park
- Fire impacts, inside and outside the park, on public and private facilities and services
- Potential fire effects

C. "Step-Up" Public Information Activities and Capabilities

The PAO will increase their involvement and number of press releases on an as-needed basis as the fire management activity increases. Staff members will be assigned to wildland fire information gathering and dissemination as needed and additional resources will be ordered on an as- needed basis through normal dispatch channels.

Fire management staff (primarily through the Fire Strategy Working Group) will seek input from the public through meetings with affected communities both inside the park and with adjoining gateway communities during the planning process for proposed hazardous fuels reduction and prescribed fire projects.

X. PROTECTION OF SENSITIVE RESOURCES

A. Cultural Resources

In accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106, impacts to cultural resources will be identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed in or eligible to be listed in the National Register of Historic Places; (3) applying the criteria of adverse effect to affected National Register eligible or listed cultural resources; and (4) considering ways to avoid, minimize or mitigate adverse effects.

Under the Advisory Council's regulations, a determination of either adverse effect or no adverse effect will also be made for affected National Register listed or eligible cultural resources. An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register, e.g. diminishing the integrity (or the extent to which a resource retains its historic appearance) of its location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the alternatives that would occur later in time, be farther removed in distance or be cumulative (36 C.F.R. 800.5, Assessment of Adverse Effects). A determination of *No Adverse Effect* means there may be an effect, but the effect would not diminish the characteristics of the cultural resource that qualify it for inclusion in the National Register. Cultural resources are non-renewable resources and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a loss in the integrity of the resource that cannot be recovered. Therefore, although actions determined to have an adverse effect under Section 106 may be mitigated, the effect remains adverse. In the unlikely event that the NPS proposed an activity that would potentially adversely affect a cultural resource, that action would require separate NEPA analysis and would not be covered under a FMP's compliance. In the event of a wildland fire, measures will be taken to avoid impacts to cultural resources.

Sites that provide evidence of Native American presence in Yellowstone include hearths, roasting pits, game drives, hunting blinds, base camps, chipping stations, rock shelters, wickiups, quarries, and tipi rings. Non- organic prehistoric resources are assumed to have survived previous wildland fires; therefore, adverse effects are unlikely. However, adverse impacts to these sites from suppression activities are possible. Effects from suppression methods include ground- disturbance from firefighter camps and associated human activity, application of retardants, use of wet- lines, and digging of handlines. Archeological sites, historic structures, ethnographical resources, and cultural landscapes that contain organic material such as wood (i.e., wickiups, fences, and signs) are more likely to be impacted from wildland fire and WFU fires and will need more active intervention for protection than non- organic sites.

Yellowstone completed Section 106 consultation under the NHPA with the MTSHPO, IDSHPO, and WYSHPO for implementation of the 2004 Update (Appendices F and G). Yellowstone will protect cultural resources during fire management activities through the following measures:

1. Planning During the Non- Fire Season

Planning during the non- fire season to incorporate cultural resource survey and mapping for protecting sensitive resources will be conducted prior to the fire season. Not all of the known cultural resource site information has been mapped in the park's Geographic Information System (GIS) database and some of the existing GIS locations are inaccurate. Cultural resource specialists will coordinate with the FMO and other fire management staff as part of the Fire Strategy Working Group to identify sensitive cultural resources and potential areas within each FMU as well as appropriate mitigation measures for suppression responses, WFU, prescribed fire, and hazardous fuels reduction treatments. The Fire Strategy Working Group is comprised of specialists in fire management, resources, and planning, and meets periodically to discuss fire management implementation and compliance during the non- fire season as well as during the fire season.

Pre- suppression planning that includes fire detection and implementation of appropriate suppression methods are key ingredients in long- term planning for protecting cultural resources from fire. Planning should include provisions for surveys and protection to precede fire line construction to avoid and/or minimize impacts to cultural resources. Planning during the non- fire season will also incorporate information annually from the preceding fire season to enable specialists to predict likely effects on cultural resources from the wildland fire management program.

Adverse effects to historic structures that are eligible for or listed in the National Register, as well as historic structures that have not been evaluated for the National Register, must be considered in the fire management planning process. As cultural resources are identified in the park, they will be evaluated for eligibility to the

National Register. If they are determined to be eligible to the National Register, they will need to be protected as necessary during all types of management responses.

2. Pre- Attack Planning During the Fire Season

The pre- attack plan is part of the park's suppression program and is reviewed annually prior to the fire season and revised as necessary by the Fire Management Committee (Appendix P). Information sources for setting suppression priorities include sensitive cultural and natural resource areas and sites, wildland urban interface, timber type, vegetation maps, wildlife habitat, fuel maps, and smoke/air quality impact models. The FMO will coordinate with cultural resource specialists for criteria to include in the pre- attack plan and convey to the Fire Management Committee who will ensure that sensitive information on values and locations stated in the pre- attack plan are protected from inappropriate dissemination. The FMO will maintain the pre- attack plan.

The park's FMO will consult with the appropriate cultural resource specialist or designated cultural resource management representative during a suppression response or a WFU fire to determine whether any cultural resources are at risk, to determine any mitigation measures to implement, or whether the work needs to be halted until formal consultation with the appropriate SHPO and associated tribes has concluded. In areas where suppression efforts are to occur, archeological surveys will be conducted in cooperation with the park archeologist, provided sufficient funding is available.

3. Minimum Impact Suppression Tactics During Suppression Responses

Yellowstone will adhere to the MIST (Appendix R) guidelines to avoid or mitigate impacts to sensitive cultural resources. These include specific mitigation measures such as fireline construction and mop- up (including ground and aerial fuels); aviation management (including retardant, foam, and water bucket use); logistics, firefighter camp sites, staging areas, helispots, and personal conduct; and restoration and rehabilitation.

4. Education

Fire management staff and resource advisors will educate fire crews on the appropriate method of protection of cultural resource sites and features during suppression, WFU, prescribed fire, and hazardous fuels reduction treatments. The methods chosen are dependent on fire behavior and the type of resource to be protected and digging of hand line to redirect the fire around or away from the feature or areas, the use of hoses to lay wet lines, sprinklers, and shelters.

5. Monitoring

Because monitoring of WFU fires may require on- the- ground holding actions, all ground- disturbing activities will adhere to the MIST guidelines. Monitoring of impacts to cultural resources during suppression responses will be conducted by fire management staff, cultural resource specialists, and resource advisors in the field. Assuming sufficient funding, cultural resource specialists will conduct post- WFU fire surveys following WFUs to determine fire effects on known cultural resources and to prepare appropriate documentation when necessary. The cultural resource specialist will consult with the SHPO if adverse effects occur or cultural resources are identified during the post- fire assessments.

B. Natural Resources

The FMO is responsible for ensuring that these identified sensitive natural resources such as wetlands and known habitat locations of sensitive plant and animal species (including threatened and endangered species) are protected to the maximum extent possible. Planning with natural resource specialists will occur prior to each fire season through the Fire Strategy Working Group and with the Fire Management Committee during the development of the WFIP in the fire season to identify and protect sensitive natural resources during fire management activities. The FMO will coordinate these planning efforts to incorporate the most recent information needed to protect sensitive natural resources. In addition, MIST tactics will be followed to the extent possible to protect sensitive natural resources.

Yellowstone will protect sensitive natural resources during fire management activities through the following measures:

1. Planning During the Non- Fire Season

Planning during the non- fire season to incorporate natural resource survey and mapping for protecting sensitive resources will be conducted prior to the fire season. Natural resource specialists will coordinate with the FMO and other fire management staff as part of the Fire Strategy Working Group to identify sensitive natural resources areas within each FMU, as well as appropriate mitigation measures for suppression responses, WFU, prescribed fire, and hazardous fuels reduction treatments. The Fire Strategy Working Group is comprised of specialists in fire management, resources, and planning, and meets periodically to discuss fire management implementation and compliance during the non- fire season as well as during the fire season.

2. Pre- Attack Planning During the Fire Season

The pre- attack plan (Appendix P) is part of the park's suppression program and is reviewed annually prior to the fire season and revised as necessary by the Fire Management Committee. Information sources for setting suppression priorities

include sensitive cultural and natural resource areas and sites, wildland urban interface, timber type, vegetation maps, wildlife habitat, fuel maps, and smoke/air quality impact models. The FMO will coordinate with natural resource specialists for criteria to include in the pre- attack plan and convey to the Fire Management Committee who will ensure that sensitive information on values and locations stated in the pre- attack plan are protected from inappropriate dissemination. The FMO will maintain the pre- attack plan.

The park's FMO will consult with the appropriate natural resource specialist or designated natural resource management representative during a suppression response or a WFU fire to determine whether any sensitive natural resources are at risk and to determine any mitigation measures to implement.

3. Education

Fire management staff and resource advisors will educate fire crews on the appropriate method of protection of natural resources during suppression, WFU, prescribed fire, and hazardous fuels reduction treatments. The methods chosen are dependent on fire behavior and the type of resource to be protected.

C. Threatened and Endangered Species

Four wildlife species that occur in the park are listed as threatened under the ESA: grizzly bear (*Ursus arctos horribilis*), Canada lynx (*Lynx canadensis*), gray wolf, non-essential experimental (*Canis lupus*), and bald eagle (*Haliaeetus leucocephalus*). No critical habitat has been designated or proposed for these species. There are no federally- listed threatened or endangered plant species in Yellowstone.

The grizzly bear, gray wolf and bald eagle are found in all of the FMUs. Ten Canada lynx detections, including three based on DNA evidence, were made in the central and east- central portion of the park within three FMUs: Mirror Plateau, Southeast, and Central Plateau. Cumulative detections represented at least four individuals, including two kittens born in two different years (Murphy et al. 2004).

Yellowstone conducted an informal programmatic Section 7 consultation under the ESA with the FWS for effects from the 2004 Update. The FWS concurred with the park's *May Affect, Not L to Adversely Affect* determinations for the threatened Canada lynx, grizzly bear, gray wolf, and bald eagle on March 28, 2005. The park will follow the avoidance and minimization measures stated in the FWS March 28, 2005, memorandum to the park, the FWS *Conservation Measures to Minimize Fire-Suppression Effects to Federally Listed Species* (FWS June 16, 2004, memorandum to federal agencies) and the national Minimum Impact Suppression Tactics for wildland fire suppression. In addition, the park will submit an annual report to the FWS that documents effects to listed species and their habitat from WFU fires and non- fire fuels management during each fire season and any adverse effects determined under ESA Section 7 Emergency Consultations. This annual report will

also identify any areas that park resource management specialists determine that may warrant suppression of a WFU fire or avoidance of suppression activities for protection of a federally listed species.

The Section 7 consultation included effects from the following components of the park's fire management plan: wildland fire suppression, wildland fire use, and eight WUI hazardous fuel reductions proposed over the next 8- 10 years. The consultation did not include prescribed fire. Any future prescribed fire projects will undergo separate Section 7 consultation if the park determines that a proposed project *May Affect* a federally listed species.

XI. FIRE CRITIQUES AND ANNUAL PLAN REVIEW

A. Fire Critiques

Fire reviews will be conducted in accordance with procedures found in RM- 18. Each review will be documented and filed with the final fire documentation. The FMO will retain a file copy.

B. Annual Fire Summary Report

The FMO is responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary, personnel utilized, hours of aircraft used, and fire effects.

C. Annual Review

The FMO is responsible for coordination of the annual review of the 2004 Update. The Superintendent is required to approve the 2004 Update of the FMP annually. Necessary updates or changes will be accomplished prior to the next fire season.

XII. CONSULTATION AND COORDINATION

The FMO is responsible for coordination and consultation with cooperators regarding fire management activities. This includes involvement with the Northern Region Coordination Group, the Northern Region Training Committee, the GYA FMOs Committee, the Eastside IMT Committee, and the West Yellowstone Interagency Fire Center, and all local cooperators that include the FMOs of the GYA.

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XIV. INDEX